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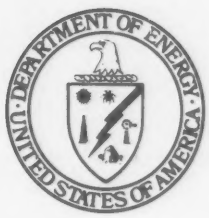
Vol. 13, No. 14
July 31, 1988

Energy Research Abstracts

Abstracts 29833-32046



Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

Current Awareness Publications for 1988

To support its research and development efforts, the Department of Energy produces a series of current awareness publications containing references to worldwide energy literature. The series includes many of the publications formerly called bulletins, as well as several new titles. These publications have new formats, and many have new titles and expanded coverage. All titles in the series are listed below by type and frequency of publication; the sponsoring DOE office is shown also. The publications listed under the heading "Current Abstracts" contain abstracts of all types of literature; those under "Current Awareness" contain abstracts and/or other kinds of information, e.g., program reports and meetings lists; and the publication under "Current Reports" contains abstracts of reports.

CURRENT ABSTRACTS

Monthly

Acid Precipitation
Advanced Oil and Gas Recovery Technologies - Fossil Energy
Clean Coal Technologies - Fossil Energy
Industrial Energy Conservation - Conservation and Renewable Energy, Office of Industrial Programs
Nuclear Fuel Cycle - Nuclear Energy
Nuclear Reactors and Technology - Nuclear Energy
Nuclear Reactor Safety - Environment, Safety, and Health
Radioactive Waste Management - Defense Programs, Nuclear Energy, and Civilian Radioactive Waste Management
Transportation Energy Research - Conservation and Renewable Energy, Office of Transportation Systems

Bimonthly

Electric Energy Systems - Conservation and Renewable Energy
Energy from Biomass and Municipal Waste - Conservation and Renewable Energy
Energy Storage Systems - Conservation and Renewable Energy
Geothermal Energy - Conservation and Renewable Energy
Ocean, Wave, and Tidal Energy Systems - Conservation and Renewable Energy
Photovoltaic Energy: Electricity from Sunlight - Conservation and Renewable Energy
Solar Buildings Technology: Solar Heating, Cooling, and Daylighting for Buildings - Conservation and Renewable Energy
Solar Thermal Energy Technology - Conservation and Renewable Energy
Wind Energy Technology: Generating Power from the Wind - Conservation and Renewable Energy

CURRENT AWARENESS

Monthly

Buildings Energy Technology - Conservation and Renewable Energy, Office of Buildings and Community Systems

Bimonthly

Energy Conversion and Utilization Technologies - Conservation and Renewable Energy, Office of Energy Utilization Research

CURRENT REPORTS

Semimonthly

Advanced Fossil Energy Technologies - Fossil Energy

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July 31, 1988

ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00703-2 and the price is $125.00 for the Volume 12 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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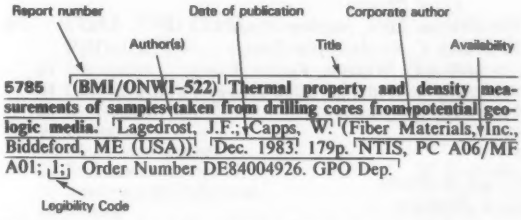
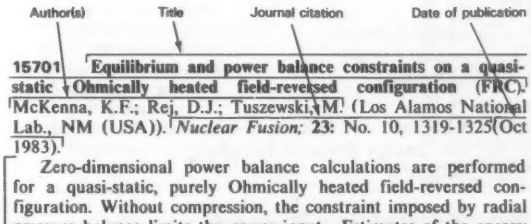
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static, Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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CEA Centre d'Etudes de Saclay
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IEA Biomass Conversion Service
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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

0103 Preparation

REFER ALSO TO CITATION(S) 29852, 29879, 29884, 30438

29833 (CONF-850982—) Second annual Pittsburgh coal conference: Proceedings. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering; USDOE Pittsburgh Energy Technology Center, PA). 1985. 886p.

From 2. annual Pittsburgh coal conference; Pittsburgh, PA, USA (16 Sep 1985).

The second annual Pittsburgh Coal Conference was held at Pittsburgh, PA, Sept. 16-20, 1985. There were 15 sessions on coal beneficiation, physical and chemical; flue for cleanup, bench scale and proof of concept testing; characterization of US coal reserves; special topics; coal liquefaction and gasification, bench scale studies and production; coal slurry fuels; waste handling and utilization; fundamental combustion studies; effects of minerals on combustion; combustion of fuel slurries; advanced combustor technology; and fluidized bed combustion. The proceedings contain 73 of the 95 papers presented. The papers have been entered individually into EDB and ERA. (LTN)

29834 (DOE/PC/79919—1) Flotation and flucculation chemistry of coals and oxidized coals: Technical progress report, September 15, 1987 to December 15, 1987. Somasundaran, P. (Columbia Univ., New York (USA)). 1987. Contract FG22-87PC79919. 25p.

This project is concerned with the investigation of mechanisms by which various collecter/frother combination reagents promote flotation of coal. Coal preparation and most of the morphological studies were completed. The morphological studies provided basic information on the nature of the sample. Large coal pieces were broken down and crushed in a Quaker mill and subsequently in a ball millusing ceramic balls. The crushed product was sieved and various size fractions stored in plastic bottles in a glove bag under nitrogen atmosphere to minimize ambient oxidation. SEM/EDXRF studies were undertaken to study the association of mineral matter in the coal matrix. Sample sof different size fractions were examined. In each instance detailed scanning was conducted and typcial micrographs and elemental distribution spectra were recorded. Results of the SEM/EDXRF analysis are summarized.

29835 (DOE/PC/79922—T1) Cyclone performance and optimization: First quarterly progress report. Leith, D. (North Carolina Univ., Chapel Hill (USA). Dept. of Biochemistry). 15 Dec 1987. Contract FG22-87PC79922. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006909/JAW.

The objectives of this project are: to characterize the gas flow pattern within cyclones, to revise the theory for cyclone performance on the basis of these findings, and to design and test cyclones whose dimensions have been optimized using revised performance theory. This work is impoortant because its successful completion will aid in the technology for combustion of coal in pressurized, fluidized beds. The project is on or ahead of schedule. During this time, the laboratory scale equipment necessary for this project has been constructed and used to make measurements of the gas flow pattern within cyclones. Tangential gas velocities for a matrix of eleven different cuclones and operating conditions have been measured. For each different test condition tangential velocities over a wide range of axial and radial positions have been measured. In addition, the literature search that began while the proposal for this work was written has been continued. The computer and printer necessary for modeling the experimental results have been ordered and received. 1 fig.

29836 (DOE/PC/81210—T18) Development and demonstration of a static tube flotation system for producing superclean coal: 10th quarterly technical progress report ending March 31, 1988. Yang, D.C. (Michigan Technological Univ., Houghton (USA). Inst. of Materials Processing). 14 Apr 1988. Contract AC22-85PC81210. 5p.

Research continued during the quarter to study the two-stage flotation circuit in various configurations at the laboratory scale and to prepare for the pilot plant scale-up tests with large packed columns (2 ft square x 20 ft high). All the research activities were designed to demonstrate the potential application of the static tube flotation technology for economic production of superclean coal (0.4-1.0% ASH) from the domestic sources. Preparatory work for PDU (Process Development Unit) testing has just been completed including the setup of the two columns and the auxiliary equipment. The first of the two bulk coal samples (25 tons of Lower Kittanning seam coal) was crushed to less than one hald inch to be used as the feed to the PDU circuit. A small portion of it representative of the bulk sample was further crushed to pass 28 mesh for testing with the laboratory unit to determine its flotation response. We have found that a stronger frother, such as pine oil, can be used to improve fine coal recovery in the packed column because of its water down-washing capability. This reagent scheme will be adopted in the PDU trial. According to the revised schedule, the project completion date will now move slightly to the end of July 1988. 1 tab.

29837 (EPRI-CS—5549) Deep cleaning Pittsburgh Seam coal for sulfur dioxide reduction: Coal Quality Development Center: Campaign report, Number 11: Interim report. Torak, E.R.; Akers, D.J.; Cavalet, J.R. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 183p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920258/JAW.

Extensive laboratry- and commercial-scale tests to characterize the cleanability of a 1500-t (1360-metric-t) shipment of raw Pittsburgh Seam coal were performed. The investigation included raw-coal analyses, laboratory froth flotation testing, and commercial-scale flowsheet cleaning tests. The potential of coal curshing to liberate impurities and the ffect of coal cleaning on combustion characteristics was also evaluated. Crushing raw Pittsburgh Seam coal facilitates sulfur, but not ash, removal. Laboratory testing of coal crushed to topsizes smaller than 34 in. (19 mm) before cleaning showed significant reduction in potential SO_2 emissions at a given level of energy recovery. Tests indicated that deep cleaning greatly improved coal quality. In one test, deep cleaning increased coal heating value from 9328 to 13,922 Btulb (21,700 to 32,390 kJkg) dry basis, reduced ash content from 34,3 to 6.2% dry basis, and decreased the SO_2 emissions potential from 9.03 to 4.93 lbMBtu (3.88 to 2.12 kgkJ). The cost of low-sulfur coal has a substantial impact on the economics of deep cleaning. 18 refs., 12 figs., 18 tabs.

29838 (EPRI-CS—5642) Cleaning lower and middle Kittanning seam coals for sulfur removal before and after blending: Coal quality development center: Campaign report number 12. Moorhead, R.G.;Torak, E.R.;Cavalet, J.R.;Arnold, B.J. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA). Homer City Office; Science Applications International Corp., Homer City, PA (USA). Homer City Office). May 1988. 245p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010315/JAW.

Cleaning Lower and Middle Kittanning Seam Coals Separately and Combined to Remove Sulfur demonstrates how different blending and cleaning strategies can affect sulfur reduction and clean-coal yield, the theoretical effects of cleaning two coals separately before blending are compared with blending the two coals before cleaning. The effects of crushing the blended raw coals to different topsizes to liberate additional ash and sulfur-bearing impurities was also evaluated. Theoretically, cleaning the two seams separately at different separating gravities to produce a clean coal with 1.86 percent sulfur increases yield by 5.4 percent over the traditional strategy of cleaning the two seams blended. Because crushing liberates more impurities from Middle Kittanning Seam than from Lower Kittanning Seam, crushing Middle Kittanning to 3/8-in. while leaving Lower Kittanning uncrushed increased yield by 9.2 percent. This theoretical investigation demonstrates that cleaning coals individually before blending may achieve sulfur specifications at higher yields than the traditional approach of blending before cleaning. Increased yield may add to the number of potential coal suppliers, which can mean more competitive coal prices and greater use of a region's coal reserve. Using commercial-scale equipment, investigators cleaned a blend of 65 percent Lower Kittanning and 35 percent Middle Kittanning coals to produce clean coals of different qualities. Laboratory-derived combustion characteristics show that these clean coals, based on standard indices, have less slagging potential than the raw-coal blend. IN addition, their ash fusibility temmperatures are higher, further reducing their slagging tendencies in dry-bottom boilers. Calculated clean-coal ash viscosities also indicate that the clean coals can be premium-quality fuels for wet-bottom boilers. 8 refs., 25 figs, 33 tabs.

29839 **(EPRI-CS—5646) Coal cleaning to improve Hub Seam combustion economics: Coal Quality Development Center: Campaign report, No. 10: Interim report.** Harrison, K.E.; Jenko, R.J.; Levasseur, A.A.; Miemiec, L.S.; Teigen, B.C.; Sun, C.Y. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA); Science Applications International Corp., Homer City, PA (USA); Combustion Engineering, Inc., Windsor, CT (USA). Power Systems Group). Mar 1988. 258p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920260/JAW.

Investigators at EPRI's Coal Quality Development Center, performed a comprehensive series of coal cleaning tests on the Hub Seam coal from Nova Scotia, Canada. These tests produced a medium- and a deep-cleaned coal for subsequent bench- and pilot-scale combustion testing. Combustion test son the raw coal and two levels of clean coal were used to estimate the capital and operating costs of three hypothetical 550 MW (gross) boilers. Results indiate that coal cleaning can improve combustion performance, offering significant equipment and operating cost savings. Equipment operating energy was reduced by 6% and 15% for the medium-cleaned and deep-cleaned coals, respectively. Desulurization system additive and waste dispoal costs were reduced over 20% for the medium-cleaned coal and over 80% for the deep-cleaned coal. These cost savings indicate that a utility can afford to pay 13% more for the medium-cleaned coal and 29% more for the deep-cleaned coal while still maintaining busbar costs equivalent to that of raw coal. 22 refs., 49 figs., 61 tabs.

0104 Processing

REFER ALSO TO CITATION(S) 29833, 29833, 29833, 29838, 29879, 29883, 29889, 29897, 29915, 29934, 30170, 30289, 30426, 30431, 30785, 30786, 31278

29840 **(CONF-880118—4) Fabrication of fiber-reinforced hot-gas filters by CVD techniques.** Stinton, D.P.; Lowden, R.A.; Chang, R. (Oak Ridge National Lab., TN (USA); Acurex Corp., Mountain View, CA (USA)). 1988. Contract AC05-84OR21400. 20p. (CONF-880118—).

From 12. annual conference on composites and advanced ceramics; Cocoa Beach, FL, USA (20 Jan 1988).

A chemical vapor deposition process was developed for the fabrication of high-temperature particulate filters. Fibrous Nicalon (SiC) felt was used as the filter material. Preliminary evaluation of filters fabricated from Nicalon revealed that cleanable filters with collection efficiencies of >99.9% could be fabricated. However, weaknesses identified during the initial testing and evaluation spurred the development of several improved filter designs for future investigation. 8 refs., 9 figs., 13 tabs.

29841 (CONF-8605117—, pp 31-34) **Great Plains - the lessons go on.** Lukes, A.C. (ANG Coal Gasification Co., Beulah, ND (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the achievements and the problems which have occurred at the Great Plains coal gasification project. It discusses problems concerning ash removal from the gasifiers and how the plant laboratory staff overcame problems with cementing. It also discusses the development of a biologically controlled plant cooling system, providing the technical background used for its development. It also discusses problems with sizing and crushing lignite which forms flakes and spears that tend to clog the pulverized fuel gasifiers. The synthetic gas production at this plant continues to develop and utilize new technology and stands as a model for coal gasification plants.

29842 (CONF-8605117—, pp 86-89) **Underground coal gasification: its role during an energy emergency and its long range potential.** Gunn, R.D. (Univ. of Wyoming, Laramie (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

In a sudden energy emergency such as that caused by the 1973 oil embargo, underground coal gasification has some advantages compared to other new energy technologies. These advantages are described. The long range potential for underground coal gasification is also promising. Nearly 20 field tests of underground coal gasification have been conducted since 1973, and most of these produced favorable results. All of these tests were on a substantial scale producing as much as 300,000 m^3 (12,000,000 scf) of gas daily. Many theoretical and laboratory studies have been completed, and much has been learned from field tests. The current state of knowledge is reviewed briefly, and major obstacles to commercialization are discussed.

29843 (CONF-8605117—, pp 90-100) **Research for low-rank coal fueled heat engines.** Honea, F.I. (Dept. of Energy, Grand Forks, ND (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

The Department of Energy (DOE) has initiated a program for the application of coal-derived fuels for use in heat engines. Large stationary gas turbines and diesel engines using low-rank coal (LRC) or LRC-slurry fuels have potential application for peak-load and emergency power generation for electric utilities and as electrical power sources for industry. Large slow-rotating engines also have potential applications in railroad locomotives. Properties of LRC are distinctive from other coals and include high alkali content, low ash content (for some LRCs), proportionately high intrinsic ash, low sulfur content and high moisture content. The LRC fuels of interest for heat engines are LRC-water slurries of dry-micronized LRC representative of physical and/or chemical beneficiation processes. Favorable properties of some LRCs particularly Powder River region subbituminous coals, are low ash and low sulfur content. These LRCs may be especially attractive candidates for indirect hot gas turbines with PFBCs or for direct coal-fired turbines. This presentation will include a brief description of the DOE METC/Grand Forks Project Office supplemental research plan for LRC-fueled heat engines. Also, current research and test results for LRC-water slurry and dry LRC powder fuel tests in a two-stage pressurized turbine simulator combustion facility will be described.

29844 **(DOE/MC/21063—2530) A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized bed gasification system: Quarterly report, August 1-September 30, 1984.** (KRW Energy Systems, Inc., Madison, PA (USA)). Nov 1987. Contract AC21-84MC21063. 255p. (FE—21063-8).

This progress report discusses activities performed during the first two months under the new contract, DE-AC21-84MC21063, which covers a 32-month gasifier mechanistic study and focuses on hot gas cleanup and combined cycle generation encompassing the development of two complementary and innovative technologies: in-bed desulfurization and external desulfurization. Detailed design of the hot gas cleanup system for external desulfurization was initiated this period, and an engineering assessment was completed which indicates in-bed desulfurization is feasible using the present PDU configuration. A test plan was prepared for the first in-bed desulfurization test, and modifications were begun to conduct this test in December 1984. PDU modifications and operations were implemented for the conduct of PDU test TP-035-4 in July and August, 1984. The first portion of this test was a cold flow test which was conducted July 19 and 20. Eleven set points were completed, varying the system pressure from 240 to 17 psig and collecting qualitative data using impact probe assemblies. The latter part of TP-035-4 was the fourth mechanistic study performed on the PDU, and it was conducted between July 24 and August 31. The fixed carbon content of the low-grade North Dakota lignite used was 26%, a value lower than any coal previously tested at the PDU. Also, during this test, a Pennsylvania anthracite coal was used to replace coke breeze which is normally used for PDU start-up, idling, and shutdown operations. It was difficult to start the PDU with these unique feedstocks, and two premature shutdowns occurred before a successful startup strategy was reached. During this report period, the topical report covering test operations at KRW cold flow scaleup facility (CFSF) was completed and test data was prepared and submitted to DOE. A theoretical analysis was completed which focused on design procedures for a multiple-jet confiugration for future testing at CFSF. 25 figs., 14 tabs.

29845 **(DOE/PC/70018—46) Coal liquefaction process solvent characterization and evaluation: Technical progress report, April 1-June 30, 1987.** Winschel, R.A.; Robbins, G.A.; Burke, F.P. (Consolidation Coal Co., Library, PA (USA). Research and Development Dept.). Feb 1988. Contract AC22-84PC70018. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88007593/JAW.

Consolidation coal Research and Development is characterizing samples of direct coal liquefaction process oils based on a variety of analytical techniques to provide a detailed description of the chemical composition of the oils, to more fully understand the interrelationship of process oil composition and process operations, to aid in plant operation, and to lead to process improvements. A set of 23 oils from Hydrocarbon Research, Inc., (HRI) was analyzed to provide information on the performance of Burning Star No. 2 mine (Illinois 6) bituminous coal, in the "demonstration" run of the Catalytic Two-Stage Liquefaction (CTSL) process. Two feed coals (cleaned and uncleaned Ohio 5/6) for HRI CTSL were analyzed. A set of microautoclave experiment was made to determine the potential benefits of a low-temperature pretreatment on donor liquefaction yields. Samples of nitric acid treated North Dakota lignite, produced at four sets of reaction conditions by JGS Research Co., Inc., were analyzed. Three cal products from Purdue Resarch Foundation were characterized by FTIR for chemical and structural information. We have composited the individual oil sampels obtained from various PDU and pilot plan runs. Two earlier reports included results obtained from the analysis of oils produced in the Signal Research/UOP continuous coal/petroleum coprocessing unit. Some of those yield data were incorrect. All appropriate re-calculations were performed. 45 refs., 32 figs., 17 tabs.

29846 **(DOE/PC/71257—T14) Novel experimental studies for coal liquefaction: Quarterly progress report, October 1, 1987-December 31, 1987.** Holder, G.D.; Tierney, J.W. (Pittsburgh Univ., PA (USA)). 1987. Contract FG22-84PC71257. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006827/JAW.

Experimental work is presently being concentrated on a two-step synthesis of methanol from CO and H_2 Which consists of the carbonylation of a molecule of methanol to methyl formate followed by hydrogenation to form two molecules of methanol. Carrying out both reactions concurrently gives different results than predicted. One explanation is interaction between the two catalysts. Since one catalyst is homogeneous and the other heterogeneous, the interaction, due to absorption of the homogeneous catalyst on the heterogeneous one, at room temperature was measured and found to be significant. Measurements of mass transfer cooefficients from gas phase to liquid phase for systems containing H_2, CO, methanol and methyl formate were made to verify that the reaction rate data being obtained are not influenced by mass transfer limitations. Mass transfer rates in the experimental reactor are a least 1000 times larger than reaction rates and hence are not rate limiting. Modeling of the unsteady state slurry phase Fischer-Tropsch reaction continued in order to investigate interactions among the Fischer-Tropsch reactions, the thermal effects, and the water gas shift reaction. A computer program for solution of the reaction equations was written. Also included in this report is the entire program for evaluating mass transfer coefficients under supercritical conditions is described and a review of current knowledge and planned correlational approaches is given. 61 refs., 22 figs, 7 tabs.

29847 **(DOE/PC/79908—T1) The hindered diffusion of coal liquids under non-reactive and high temperature and pressure reactive conditions: Quarterly report No. 1, September 15, 1987-December 14, 1987.** Tsotsis, T.T.; Sahimi, M.; Webster, I.A. (University of Southern California, Los Angeles (USA). Dept. of Chemical Engineering). [1988]. Contract FG22-87PC79908. 17p.

One of the main obstacles in the design and optimization of catalytic coal liquefaction and petroleum and coal-liquid hydroprocessing reactors, today, is the lack of available experimental transport, thermodynamic and reaciton data at realistic process conditions. It is the goal of this project to provide for a better fundamental understanding of these basic questions and issues and the generation of a complete set of experimental transport and reaction data, under well controlled realistic process conditions, and this will enhance the ability to optimize existing coal liquefaction processes, reduce the severity of currently utilized operating conditions, and help in the systematic search for more active catalytic materials and modification additives.

29848 **(DOE/PC/79933—T1) Effectiveness factors for hydroprocessing of coal and coal liquids: Progress report No. 1, September 15, 1987-December 14, 1987.** Massoth, F.E.; Seader, J.D. (Utah Univ., Salt Lake City (USA). Dept. of Chemical Engineering). 30 Dec 1987. Contract FG22-87PC79933. 10p.

The aim of this research project is to develop a methodology to predict, from a knowledge of feed and catalyst properties, effectiveness factors for catalytic hydroprocessing of coal and coal liquids. To achieve this aim, it is necessary to account for restrictive diffusion, which has not hitherto been done from a fundamental approach under reaction conditions. The research proposed here entails a study of hydrodenitrogenation of model compounds and coal-derived liquids using three NiMo/alumina catalysts of different pore size to develop for restrictive diffusion, a relationship that can be used for estimating reliable effectiveness factors. The research program is divided into four parts: measurement of pertinent properties of the catalysts and of a coal liquid and its derived boiling-point cuts; determination of effective diffusivities and porosities of the catalysts; development of restrictive diffusion correlations from data on model N-compounds at reaction conditions; and testing of correlations with coal-liquid cuts and a whole coal-liquid feed, modifying correlations as necessary. 3 figs., 1 tab.

29849 **(DOE/PC/79936—1) Low severity conversion of activated coal: Quarterly report No. 1 for the period September 8, 1987 through December 1, 1987.** Hirschon, A.S.; Ross, D.S. (SRI International, Menlo Park, CA (USA)). Dec 1987. Contract AC22-87PC79936. 15p.

We have made advances in both the thermal and hydrotreating stages that can be applied to develop a rational coal liquefaction

scheme. The objecties of this project are follows: (1) develop an understanding of the hydrothermal pretreatment chemistry and its optimization at temperatures and pressures no greater than 250{degree}C and 1000 psi; (2) develop a series of highly reactive and dispersible promoters of bond hydrogenolysis operating at temperatuers no grater than 300{degree}C; and (3) successfully combine the pretreatment and hydrotrating steps to yield coal products with ethyl acetate or toluene solubilities no less than 85%. To date we have looked at the effect of time of pretreatment of coal under nitrogen and water at 250{degree}C. The pretreatment period is critical, and the maximum effect is achieved after only brief heating of the coal. After 30 minutes at this temperature, there is not longer a pretratment benefit. We also synthesized and tested sulfided NiW and RuNiW catalysts supported on alumina for HDN activity to compare with the high-activity-promoted molybdenum-based catalysts. RuNiW is the more selective toward hydrogenolygis of C-N bonds however, it is not as active as the other ruthenium-promoted catalysts.

29850 **(DOE/PC/80910—T2) A study of depolymerization and crosslinking reactions in coal liquefaction: Ninth quarterly report, September 1, 1987-November 30, 1987.** Solomon, P.R.; Deshpande, G.V.; Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). 1987. Contract FG22-85PC80910. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007643/JAW.

The major goal of this program is to characterize the depolymerization and crosslinking reactions of low rank coals and determine how they can be optimized in liquefaction by combining high heating rates with solvent interctions. High heating rates are achieved by using a heated tube reactor where coal is heated at about 20,000/sup degree/Csec. Solvent interactions to stabilize depolymerization fragments formed at high heating rates are achieved by: (1) co-injection of a donor solvent into the heated tube reactor;(2) preswelling the coal at elevated temperatures (100{degree}C) and pyrolyzing the swelled coal in the heated grid or heated tube reactors and (3) injecting rapidly preheated coal into a hot solvent. The solvent used for swelling experiments was pyridine which disrupts hydrogen bonds and therefore results in maximum swelling. Chlorobenzene is unable to disrupt these hydrogen bond and so produces less swelling. Chlorobenzene was used in some of the swelling experiments to compare the swelling behavior of chars in these two solvents. The swelling due to chlorobenzene for coal and chars formed under a variety of pyrolysis conditions was found to be lower than that due to pyridine. This is because chlorobenzene is unable to disrupt the hydrogen bonds like the pyridine does. For lignite chars, swelling is low with chlorobenzene due to early crosslinking. For bituminous coal chars, swelling due to chlorobenzene could be higher than the parent coal under conditions where hydrogen bonds have been disrupted due to pyrolysis but not many new crosslinks have been introduced due to crosslinking. 10 refs., 3 figs., 2 tabs.

29851 **(DOE/PC/90016—T1) Feasibility of producing jet fuel from GPGP [Great Plains Gasification Plant] by-products: Quarterly technical progress report for the period November 17, 1987-February 16, 1988.** Willson, W.G.; Knudson, C.L.; Rindt, J.R.; Smith, E. (North Dakota Univ., Grand Forks (USA). Energy and Mineral Research Center). 1988. Contract AC22-87PC90016. 20p.

The primary objective of this project is to assess the technical and economic feasibility of producing aviation turbine fuel from by-product streams of the Great Plains Gasification Plant located in Beulah, North Dakota. A secondary goal of the project is to assess the conversion of the by-products streams into a new, higher-density aviation fuel. GPGP currently produces 150 MM SCFD of synthetic natural gas from 16,000 tpd of North Dakota lignite. In addition, the plant generates three liquid hydrocarbon streams: 730 barrels per day (BPD) naphtha, 880 BPD phenols, and 3200 BPD tar/oil. Work has focused on two tasks performed in support of these objectives. The first task consisted of a detailed analysis of the by-product streams under consideration. These data confirm that the primary feedstock for upgrading to jet fuel is the approximately two-thirds of the tar/oil stream remaining after phenolics are removed by solvent extraction. The second task involves an engineering evaluation of by-product upgrading. Both single-stage and two-stage processing are being evaluated. Results of the first-stage testing indicated that it is possible to remove essentially all of the heteroatoms. These data led to an empirical model relating heteroatom content to temperature and pressure by the following equation: [HA] {equals} 3.43 {minus} 2.04 * X1 {minus} 0.67 * X2 where X1 {equals} (t {minus} 360)/30 and X2 {equals} (p {minus} 2000)/500 with t and p expressed in degrees C and p in psi, respectively. A linear relationship appears to exist when comparing aromatic hydrogen content and temperature. 10 refs., 2 tab., 3 figs.

29852 **(DOE/PC/90017—T18) Cooperative research in coal liquefaction infratechnology and generic technology development: Quarterly report, October 1, 1987-January 1, 1988.** Huffman, G.P.; Sendlein, L.V.A. (Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (USA)). 1988. Contract FC22-86PC90017. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006654/JAW.

Research programs of coal liquefaction continued. Results are presented in the following areas. Increasing the airCO_2 ratio of the aeration stream has been found to increase the biodesulfurization rate of coal. Further acclimatization studies using S. brierleyi were conducted, achieving removal of 28% of the organic sulfur in a Kentucky coal. Catalysts were tested in coprocessing experiments including $ZnCl_2$, $SnCl_2$, and Fe and Mo species. Good conversions and product yields we obtained. A new concept, based on pretreatment of heavy oils using transition metal carbonyls to increase their hydrogen content, is being tested. NMP extraction experiments have been conducted on several new coals, with MAF extraction percentage ranging from 33 to 67%, and on two tar sands which yielded extractions of a viscous oil of approximately 70% MAF. The collection of data at several tempertures has been initiated. The role of the solvent in coal liquefaction is reviewed with respect to: (1) the role in the early staes of liquefaction;(2) the experimental ranking of hydrogen donor solvents leading to the actual mechanisms proposed to affect hydrogen transfer;(3) the role of a catalyst, as it affects the hydrogen donor solvent. Selectivity and reactivity studies of the oil soluble catalyst molybdenum napthanate were largely completed. A mathematial model has been developed to simulate the behavior of bimodal catalysts. A study was made of naphthalene hydrogenation at low severity conditions, using Raney nickel and supported palladium and platinum catalysts. Gas-liquid mass transfer and catalyst deactivation were found to be controlling factors.

29853 **(DOE/PC/90523—13) Phase equilibrium data for development of correlations for coal fluids, January 15, 1988-April 15, 1988.** Robinson, R.L. Jr.; Gasem, K.A.M.; Raff, A.M.; Darwish, N. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 1988. Contract FG22-86PC90523. 12p.

The effective design and operation of processes for conversion of coal to fluid fuels require accurate knowledge of the phase behavior of the fluid mixtures encountered in the conversion process. Multiple phases are present in essentially all stages of feed preparation, conversion reactions, and product separation; thus, knowledge of the behavior of these multiple phases is important in each step. The overall objective is to develop accurate predictive methods for representation of vapor-liquid equilibria in systems encountered in coal-conversion processes. Data have been obtained on the solubility of ethane in n-hexane at 310.9 K, 338.7 K, 366.5 K, and 394.3 K. 5 refs., 3 figs., 2 tabs.

29854 **(DOE/PC/90529—T1) Microprobe diffusion in coal chars under reactive conditions: Annual topical report, 15 September 1986-15 September 1987.** Calo, J.M.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1987. Contract FG22-86PC90529. 65p.

It has been established that mass transport in pores of molecular dimensions in coals and coal chars is an activated process. The rate of activated diffusion under typical coal processing conditions can be at least an order of magnitude slower than Knudsen diffusion, and, of course, even slower in comparison to ordinary bulk diffusion. The current project is concerned with the development and application of a new technique to measure micropore diffusion under actual gasification conditions. The method is an outgrowth of

and related to the transient kinetics approach to the measurement of kinetic rate parameters for char-gas reactions that has been developed in our laboratory. It can be shown that the initial transient behavior of a species introduced as a step-function into a "gradientless" reactor in which char is present, is controlled by the transport resistance offered by the char micropores. Therefore, this data can be analyzed for micropore diffusion time constants. In addition, due to the time-resolved nature of the process in the reactor, the initial diffusion step is separated (in time) from any subsequent gas-solid reaction steps. Therefore, diffusion measurements can be performed under gasification conditions. Since the primary experimental variables to be examined in this study, other than gas species type, are pressure and temperature, we have considered the potential effects of these variables on our data. The new contribution to this area from our work will be in measuring activation energies and other appropriate model parameters under reactive conditions. The development of a numerical model of activated diffusion in char micropores has also been undertaken and is intended as a tool for comparison and interpretation of the data. The principal technique is a Monte Carlo method whereby the diffusion process is simulated by the random motion of gas phase species in a randomly constructed pore network.

29855 **(DOE/PC/90534—9) Supercritical fluid chromatography/supersonic jet spectroscopy: Progress report, December 1, 1987-Feburary 29, 1988.** Goates, S.R.; Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90534. 10p.

Work has included exploration of the characteristics of the high-pressure sheath flow nozzle for use with supersonic jet spectroscopy, preliminary testing of the direct-expansion pulsed nozzle, packed-column supercritical fluid chromatography experiments with direct-expansion supersonic jet fluorescence spectroscopy, and continued development of the pulsed, low-pressure sheath-flow nozzle and of a fully degenerate four-wave mixing detection scheme. We have obtained very good spectra of perylene with the high pressure sheath-flow nozzle. The entire nozzle asembly was heated by a thermal coaxial heater wrapped around the nozzle body, and the heating effect was further enhanced by putting a small copper tube along the tip of the column restrictor. Examination of the temperature gradient by the method described in our last report helped us to properly configure the heater, and now we are constructing a more practical (less jury-rigged) heater. 3 refs., 3 figs.

29856 **(DOE/PC/90538—6) Use of basic nitrogen to chemically clean coal:.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 16 Mar 1988. Contract FG22-86PC90538. 8p.

Studies of the effect of the concentration of basic model nitrogen compounds in coal derived distillate solvents were continued. Based on results obtained from runs made using solvents containing 5 wt% basic nitrogen compounds, studies of the effect of adding 25 wt% of two of the more effective basic nitrogen compounds were initiated. Results obtained using 2, 2, 6, 6-tetramethylpiperidine (TMP) have been analyzed. Increasing the weight ratio of TMP to solvent increased the desulfurization reaction of the lignite in an atmosphere of carbon monoxide plus water and of the subbituminous coal in an atmosphere of hydrogen. Otherwise no significant positive effectson desulfurization or pyridine conversion were found. 2 tabs.

29857 **(PB—88-171285/XAB) Production of high-density electrode-grade carbon from coal. Final report.** Smith, M.A.; Welch, B.J. (Auckland Univ. (New Zealand)). Sep 1987. 43p. NTIS, PC E03/MF A01.

This report summarizes the findings of an investigation into the carbonization of coals (with an emphasis on the low-ash West Coast South Island coals), that was aimed at seeing whether the basic carbonaceous raw material for various electrode-grade carbon could be derived from the coal. Of the commercial electrode-grade carbons - anode coke for aluminium smelting, smelter cathodes, Soderberg grist, and graphite electrode base - the greatest emphasis was placed on anodes for use in aluminium smelting, since this has the greatest potential market. Furthermore, earlier investigations resulted in carbons that showed promise of satisfying some of the specifications could be produced from this coal.

29858 **(PB—88-181300/XAB) Reaction of calcium-based sorbents with sulfur compounds during gasification. Annual report, October 1, 1986-September 30, 1987.** Rehmat, A.; Abbasian, M.J. (Institute of Gas Technology, Chicago, IL (USA)). Jan 1988. 69p. NTIS, PC A04/MF A01.

This report outlines the objectives and the data obtained under the project related to the efficient utilization of high-sulfur Illinois coal in a One-Step Coal Gasification/Desulfurization Process by employing in-situ removal of sulfur using calcium-based sorbents. The scope of the research included a study of fluidization behavior of coal char/sorbent mixtures and the reactions of calcium-based sorbents with sulfur present in the coal during gasification. Tests were conducted in bench-scale units; an 8-inch (0.2 meter) fluidization column was utilized for fluidization tests, and a thermobalance reactor was used for gas/solid sulfidation and sulfation reactions. The test parameters included the choice of sorbent, sorbent size, the effect of temperature on the sulfidation and sulfation reactions, the effect of the steam-to-hydrogen sulfide ratio on the sulfidation reaction, the effect of the steam on the sulfation reaction, and the influence of exposure time on sulfation of the presulfided sorbent. The reaction conditions for these reactions were chosen to be applicable to scale-up of an in-situ desulfurization-type coal gasification process such as the one proposed by the Institute of Gas Technology (IGT) and KRW Energy Systems, Inc., of the USA.

29859 **(PB—88-197140/XAB) Characterization, extraction, and reuse of coal-gasification solid wastes. Volume 1. Characterization of coal gasification solid wastes. Final report, May 1983-June 1986.** McCarthy, G.J.; Stevenson, R.J.; Hassett, D.J. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Mar 1988. 265p. NTIS, PC A12/MF A01.

See also Volume 2, PB—87-230223.

Coal gasification, such as that underway at Beulah, ND, results in large quantities of by-product ash that must be either utilized commercially or disposed in landfills. Detailed ash characterization is necessary for either option. Chemical composition (by AAS, ICP and XRF), mineralogy (by XRD and SEM) and thermal analysis (by TGA) were determined for nine fixed-bed low-rank coal (lignite) ash samples prepared over a five-year period in three gasifiers representing a range of operating conditions. The ashes are coarsely granular and show considerable grain-to-grain heterogeneity. They have higher concentrations of Na_2O, CaO, and MgO and lower concentrations of Al_2O_3 and SiO_2 than bituminous coal ash. Their trace-element concentrations are typical of lignite combustion ashes. Unlike the combustion ashes, the gasification ashes are dominantly crystalline with an assemblage of mineral-like silicates (melilite, merwinite, dicalcium silicates, nepheline, carnegieite, sodalite, feldspars), oxides (periclase, ferrite spinel, quartz) and calcite. Glass phases are rich in sodium aluminosilicate.

29860 **(SAND—87-2544C) Hydrocarbon conversions with hydrous metal oxide catalysts.** Stephens, H.P.; Dosch, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880602—2).

From 9. international catalysis congress; Calgary, Canada (26 Jun 1988).

Catalysts prepared by dispersing Ni, Mo, and combinations of Ni and Mo on the sodium form of hydrous oxides of titanium (HTO), zirconium (HZO), and niobium (HNO) by an ion exchange process were tested for use in direct coal liquefaction. Conversion of coal to oil, as measured by the amount of product having a molecular weight less than {similar←to}250, was a function of the active metal used with Mo catalysts yielding higher conversions than Ni catalysts. Conversion was also proportional to the Mo/Ni atomic ratio for catalysts containing both metals. In contrast, hydrogen consumption for the liquefaction experiments was a function of not only the active metal (Ni, Mo), but also the hydrous metal oxide support (HZO, HNO, HTO). Comparison of the results for the hydrous metal oxide catalysts with those for a Ni-Mo/alumina catalyst demonstrated that the Mo hydrous metal oxides were as effective for conversion of coal and the Mo HZO catalyst consumed significantly less hydrogen. 8 refs., 1 figs. 1 tab.

29861 **(SAND—88-0813C) Performance of hydrous titanium oxide-supported catalysts in coal-liquids upgrading.** Cillo, D.L.; Smith, D.N.; Ruether, J.A.; Stephens, H.P.; Dosch, R.G. (USDOE Pittsburgh Energy Technology Center, PA; Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880604—8). NTIS, PC A; 02/MFA 01; GPO Dep. Order Number DE88007602/JAW.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

Experimental tests were performed in a continuous-flow hydrotreating unit at Pittsburgh Energy Technology Center to evaluate the performance of hydrous titanium-oxide supported (HTO) catalysts as hydrotreating catalysts for use in two-stage coal liquiefaction. Catalysts containing either a combination of CO, Ni, and Mo as the active metal components or Pd as the active metal componet were tested with representative hydrotreater feed stocks from the Wilsonville Advanced Coal Liquefaction Research and Development Facility. Catalyst performance evaluation was based on desulfurization and denitrogenation activity, the conversion of cyclohexane-insolbule material, and hydrogenation activity during 100-hour reactor runs. Results indicated that the HTO catalysts were comparable to a commercial Ni/Mo-alumina supported catalyst in the areas evaluated. 11 refs., 1 fig., 6 tabs.

29862 **(SAND—88-7084C) Economics of coal liquids revisited.** Gray, D.; Tomlinson, G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 18p. (CONF-880495—1).

From Alternate energy conference; Napa, CA, USA (5 Apr 1988).

Over the past decade continued research and development in the production of liquid fuels from coal has substantially increased both the quantity and the quality of distillate from a ton of coal. This increase of distillate which amounts to approximately 35 percent has resulted in a real significant decrease in the cost of liquid products from coal. Continued research in this area is still expected to further reduce the cost of coal liquids. We believe that with present technology, and with economic assumptions which are reasonable for this time period, high qualitly synthetic liquids from coal can be produced for around $35, and that they would be competitive with sweet crude oil selling for as low as $30. 14 refs., 5 figs., 5 tabs.

29863 **Westinghouse to scale up hot gas ceramic cross-flow filter for coal gasification plants.** *Fossil Energy Review;* 8(Jan-Feb 1988).

A two-year, $1.3 million federal contract calls for Westinghouse to scale up an innovative ceramic cross-flow filter and test it at a coal gasification pilot plant operated by Texaco Inc. Under development since the late 1970s, the filter is projected to be capable of capturing more than 99% of the tiny particles of mineral matter and ash that are swept out of a gasifier when coal is gasified. Conventional particulate removal technology work effectively but only at relatively low temperatures - around 200 °F or less. This requires the coal gases, which can be as hot as 1000-3000°F, to be cooled before they are cleaned, a step that reduces plant efficiency and increases costs. The ceramic cross-flow filter reduces the cooling requirement by removing particles at temperatures of 1500°F or higher. Combined with high-temperature sulfur removal devices, the ceramic filter could permit a future coal-fired power plant to meet all federal and state emission standards using existing coal gasifiers connected to conventional gas turbines. The filter, to be fabricated for Westinghouse by Coors Porcelain of Golden, CO, is essentially a box of corrugated layers, each layer positioned at a right angle to the one below it. The ceramic material used to fabricate the floor and ceiling of each layer is porous permitting the hot coal gases to pass through while trapping the particulate matter. Particle-laden coal gases blown in through one side of the corrugated element pass through the gas-permeable layers and emerge at right angles cleaned of their impurities.

29864 **Activity of Pd(110) for methanol synthesis.** Berlowitz, P.J.; Goodman, D.W. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Catalysis;* **108**: No. 2, 364-368(Dec 1987). Contract AC04-76DP00789.

The synthesis of methanol from CO and H_2 has been studied over unsupported, single-crystal Pd(110) at pressures of 72.3-244 KPa, temperatures of 493-553 K, and a H_2/CO ratio of 3.9, in a combined high-pressure reactor/UHV surface analysis chamber. At 244 KPa the reaction exhibited linear Arrhenius behavior with an activation energy of 18.4 +/- 1.9 kcal/mol, and a pre-exponential factor of 8×10^4 s^{-1}. These values are in good agreement with values reported for supported Pd/SiO_2. At 553 K the reaction was roughly first order in total pressure (1.2 +/- 0.2) over the pressure range studied. Specific rates (turnover frequencies) observed in this study, extrapolated to pressures typical of most methanol synthesis work (1-1.5 MPa), are in good agreement with rates observed for Pd dispersed on noninteracting supports such as SiO_2, and some basic supports such as ZnO and MgO. These rates are higher than those observed over Pd supported on zeolite and acidic supports (e.g., PdNaY and Al_2O_3), but much lower than those observed on highly active La_2O_3-supported Pd. In addition, no dimethyl ether product was detected on Pd(110), though it is a significant product on many acidic supports. Thus, Pd metal is an active methanol synthesis catalyst, and no specific support interaction is required. Highly interacting supports exhibit rates and/or selectivities substantially different from those of Pd(110).

29865 **Catalysis over molybdenum carbides and nitrides. II. Studies of CO hydrogenation and C_2H_6 hydrogenolysis.** Ranhotra, G.S.; Bell, A.T.; Reimer, J.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **108**: No. 1, 40-49(Nov 1987). Contract AC03-76SF00098.

The hydrogenation of CO and the hydrogenolysis of C_2H_6 were studied over the hcp and fcc phases of Mo_2C, and the fcc phase of Mo_2N. The CO hydrogenation activity and selectivity of the fcc phases of Mo_2C and Mo_2N are identical. The activity of the hcp phase of Mo_2C is half that of the other two catalysts but the olefin selectivity is higher. Elemental analysis reveals that the catalysts contain a substantial amount of oxygen following extended use for CO hydrogenation. The hydrogenolysis activity of both Mo_2C phases increases markedly with decreasing content of oxygen in the catalyst. Consistent with the known structure sensitivity of C_2H_6 hydrogenolysis, the activity of the hcp phase of Mo_2C is 200-fold higher than that of the fcc phase. This difference in activity is attributed to differences in the structure of the principal planes exposed by each phase of the carbide. 32 references.

29866 **Characterization of H_2 adsorbed on γ-Mo_2N by NMR spectroscopy.** Haddix, G.W.; Reimer, J.A.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **108**: No. 1, 50-54(Nov 1987). Contract AC03-76SF00098.

Nuclear magnetic resonance (NMR) techniques were used to study hydrogen dissociatively adsorbed on high-surface area (~ 120 m^2/g) γ-Mo_2N. Based upon proton NMR measurements, the authors conclude that hydrogen adsorbs on the surface of γ-Mo_2N in the form of rafts of localized hydrogen atoms which occupy only 10% of the total BET surface area. Furthermore, the authors conclude that the surface hydrogen is strongly bound to the catalyst. The implications of these conclusions for the details of hydrogen adsorption sites and ammonia synthesis are discussed. 15 references.

29867 **Influence of butene of CO hydrogenation over ruthenium.** Jordan, D.S.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **108**: No. 1, 63-76(Nov 1987). Contract AC03-76SF00098.

Reactions of 1-C_4H_8 with H_2 and CO were investigated over $RuSiO_2$. To identify the sources of carbon in the products, ^{13}CO and unlabeled 1-C_4H_8 were used and product analysis was carried out by isotope-ratio gas chromatography-mass spectrometry. Butene undergoes extensive hydrogenation and isomerization in the absence of CO. The production of small quantities of C_1-C_3 and $C_6\mu$ paraffins is also observed, indicating hydrogenolysis and homologation of C_4H_8. The observed product distribution is described by a chain growth scheme involving C_1 and C_4 monomer units. Butene added to synthesis gas strongly influences the reactions of CO while undergoing reactions itself. With increasing C_4H_8 partial pressure, hydrocarbon formation from CO is suppressed but the production of pentanal and pentanol via hydroformylation is enhanced.

The rate of C_4H_8 homologation increases with increasing C_4H_8 pressure, resulting in higher overall rates of production of $C_5\mu$ hydrocarbons in the $C_4H_8H_2CO$ reaction than those in the H_2CO reactions. Implications of these results on the chain growth mechanism are discussed. Comparisons are made among the reactions of C_4H_8, C_2H_4, and C_3H_6 with synthesis gas. It is concluded that the efficiency of the olefin in producing monomers that are active in chain growth decreases in the order $C_2H_4 > C_3H_6 > 1\text{-}C_4H_8$. 26 references.

29868 Influence of propylene on CO hydrogenation over silica-supported ruthenium. Jordan, D.S.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **107**: No. 2, 338-350(Oct 1987). Contract AC03-76SF00098.

Reactions of C_3H_6, H_2, and CO were studied over $RuSiO_2$. Processes of hydrocarbons chain growth were investigated by comparing product distributions observed in the reactions of C_3H_6 and H_2, and of C_3H_6, H_2, and CO. In the latter experiments, the source of carbon in the products was identified by using ^{13}C-labeled CO and unlabeled C_3H_6 and analyzing the products by isotope-ratio gas chromatography-mass spectrometry. Hydrogenation to C_3H_8 is the dominant reaction in the absence of CO. Small conversions of C_3H_6 to CH_4, C_2H_6, and $C_4\mu$ products are also observed. Schemes for C_3H_6 hydrogenolysis and hydrogenation are discussed and a chain growth mechanism for C_3H_6 homologation is proposed. The latter involves C_1, C_2, and C_3 monomer units and is shown to describe the observed product distribution. The presence of CO enhances homologation relative to hydrogenolysis and suppresses hydrogenation. The addition of C_3H_6 to a COH_2 feedstream reduces the rate of CO hydrogenation to form hydrocarbons. However, the overall rates of production of $C_4\mu$ hydrocarbons increase with increasing C_3H_6 partial pressure as a result of C_3H_6 homologation. The formation of butanal and butanol via hydroformylation is also observed. Comparisons between the reactions of C_2H_4 and C_3H_6 are made and implications of their similarities and differences are discussed.

29869 Secondary reactions during CO hydrogenation on zeolite-supported metal catalysts: influence of alkali cations. Oukaci, R.; Wu, J.C.S.; Goodwin, J.G. Jr. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **107**: No. 2, 471-481(Oct 1987). Contract FG22-83PC60805.

The effect of neutralizing cations on the secondary reactions of the primary products from CO hydrogenation over ion-exchanged zeolite-supported Ru catalysts was investigated using zeolites with different alkali cations (Li^+, Na^+, K^+, Rb^+, Cs^+). The transformation of olefins (propylene and butene) on the zeolites without the metal, under conditions similar to those used for CO hydrogenation, was also studied in order to understand the effect of the various constituents of the support, i.e., the Broensted acid sites generated during catalyst preparation and the alkali cations, on possible secondary reactions of the primary olefinic products. It was established that secondary acid-catalyzed reactions of these primary products can play a major role in shaping product selectivity during CO hydrogenation over zeolite-supported catalysts. Depending on the concentration and the strength of the acid sites, various competitive reaction paths can be observed for the transformation of the olefinic compounds. These include isomerization, oligomerization, polymerization, and cracking. The strength of the acid sites was found to be strong function of the nature of the neutralizing alkali cations remaining in the zeolite. The presence of Li^+ produced the strongest acid sites resulting in more oligomerization over LiHY than even HY. Acid site strength decreased with the molecular weight of the alkali cation used.

29870 Enhancement of CO hydrogenation of rhodium by TiO/sub x/ overlayers. Levin, M.E.; Salmeron, M.; Bell, A.T.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **106**: No. 2, 401-409(Aug 1987). Contract AC03-76SF00098.

The kinetics of CO hydrogenation at atmospheric pressure over a polycrystalline Rh foil with titania deposits were characterized with respect to the surface composition. The titania overlayers (TiO/sub x/, $x \sim 1.9$) were prepared by titanium evaporation under ultrahigh vacuum with subsequent oxidation. Coverages were determined by Auger electron spectroscopy (AES). A sharp maximum in methanation activity, relative to the clean Rh surface, was observed with coverage. A threefold enhancement in activity was found for a TiO/sub x/ coverage of 0.15 of a monolayer. The increase in rate at low coverages was accompanied by a higher selectivity toward olefins (10% → 31%), a lower activation energy (24.4 → 16.8 kcalmol), a higher H_2 reaction order (1.0 → 2.6), and a higher CO reaction order (-1.0 → -0.3). The kinetic parameters for olefin production were noticeably different than those for paraffin production as well. The dependence of the activity on TiO/sub x/ coverage has been modeled through a Monte Carlo simulation assuming the existence of sites of high activity at the oxide-metal interface. This model is consistent with the premise of Ti^{2+} participation in the dissociation of CO. 33 references.

29871 Dispersed cobalt-containing zeolite Fischer-Tropsch catalysts. McMahon, K.C.; Suib, S.L.; Johnson, B.G.; Bartholomew, C.H. Jr. (Univ. of Connecticut, Storrs (USA)). *Journal of Catalysis;* **106**: No. 1, 47-53(Jul 1987).

Microwave discharge methods have been used to prepare highly dispersed cobalt clusters in zeolites. Ferromagnetic resonance, electron microscopy, and H_2 chemisorption experiments have been done to determine the particle sizes of the cobalt clusters. These materials were also studied as Fischer-Tropsch catalysts. Catalytic results suggest that these cobalt zeolite catalysts show high selectivity for the production of low-molecular-weight olefins. Evidence of shape selective catalysts with a cutoff at the C_6 chain length has also been observed. Their results are also in line with the concept of structure sensitivity. 26 references.

29872 Preparation effects in zeolite-supported metal catalysts: influence of decomposition/reduction on Ru particle size. Oukaci, R.; Sayari, A.; Goodwin, J.G. Jr. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **106**: No. 1, 318-322(Jul 1987). Contract FG22-83PC60805.

Ruthenium is a highly active catalyst for numerous reactions, such as CO hydrogenation. A very successful method for preparing highly dispersed zeolite-supported Ru catalysts is by ion-exchange of the zeolite with ruthenium hexammine chloride. The ion-exchange is followed, after drying, by the thermal decomposition of the Ru hexammine complex ion and reduction in hydrogen at 673 K of Ru to its metallic form. The ability to prepare highly dispersed zeolite-supported metals having comparable dispersions and metal distribution is crucial in understanding the effect of other variables and in making full use of all the benefits of zeolites as supports. This note discusses the influence of the decomposition/reduction procedure on the physical characteristics of Y-zeolite-supported ruthenium catalysts when alkali cations other than sodium are used to neutralize the zeolite framework. 22 references.

29873 Synthesis of oxygenates from CO and hydrogen over supported metal clusters. Pierantozzi, R. (Air Products and Chemicals Inc., Allentown, PA (USA)). *Journal of Catalysis;* **106**: No. 1, 323-326(Jul 1987). Contract AC22-80PC30021.

Metal clusters serve as precursors to highly dispersed or unique supported metal catalysts. While numerous studies describe the preparation and characterization of cluster derived catalysts, only a few describe their use for selective synthesis gas reactions. For these reactions, the product type (i.e., oxygenates or hydrocarbons) is generally similar to that produced on conventionally prepared catalysts. The authors reports here studies on supported metal cluster derived catalysts for CO hydrogenation that illustrate the differences between cluster precursors and conventional precursors. The author shows that cluster precursors can result in product types that are different than those produced by conventional catalyst preparations. The paper also shows that the choice of cluster and support is critical in determining the product distribution. Two types of catalyst systems were studied: an anionic metal cluster based on Fe and Mn impregnated on MgO, Al_2O_3, or ZrO_2/Al_2O_3; and Ru carbonyl clusters on TiO_2. 12 references.

29874 Characterization of Alaskan coals: evaluation of their liquefaction behavior. Youtcheff, J.S. Jr. (Univ. of Alaska, Fairbanks (USA)). pp 366-375 of Focus on Alaska's coal '86. Rao, P.D. (ed.). Fairbanks, AK; Univ. of Alaska (1986). (CONF-861071—). Contract FG22-84PC70774.

From Focus on Alaska's coal '86; Anchorage, AK, USA (27 Oct 1986).

Nineteen coals, representing seven of Alaska's coal fields, were liquefied in batch reactors at 425°C with tetralin. A number of correlations between conversion yield and coal characteristics were examined. The lignite and subbituminous coals from the Little Tonzona, Nenana, Beluga and Yukon Flats coal fields were found to be readily converted to a THF soluble product. Conversion yields for these coals were greater than 84% (daf basis). The bituminous coal from the Matanauska coal field and the inertinite-rich coals from the Northern Alaska and Chicago Creek coal fields were considerably less reactive; conversion yields from 55% to 82% were attained. Evaluation of the distribution of liquefaction products showed that the low-rank coals were readily converted into low molecular weight components (oils plus gases); few asphaltenes and preasphaltenes were generated. The inertinite-rich coals were found to produce a balanced distribution of the different product classes. Two of the coals which consist of appreciable amounts of pseudovitrinite, were found to generate predominantly the high molecular weight preasphaltenes. These were converted into asphaltenes under conditions of greater severity. 16 references, 7 figures, 2 tables.

0105 By-products

REFER ALSO TO CITATION(S) 29913, 29988

29875 (CONF-8605117—, pp 126-131) **Technology development: relationships among physical, chemical and toxicological properties of coal conversion materials.** Gray, R.H.; Drucker, H.; Massey, M.J.; Craun, J.C.; Fillo, J.P.; Reilly, C.A.; Renne, R.A.; Wilson, B.W. (Pacific Northwest Lab., Richland, WA (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Over the last decade, a substantial database has been developed concerning the physical, chemical and toxicological properties of coal conversion (liquefaction and gasification) materials. This work evaluated products and byproducts obtained from processes that, in many cases, were operated under a variety of conditions and configurations. The authors recently completed a major effort involving several laboratories, organizations, and individuals to compile, integrate and evaluate the chemical, physical, toxicological and engineering database that was developed. This paper summarizes the results of that effort, soon to be published in book form, and indicates those properties/characteristics (i.e., boiling point and degree of aromaticity) of coal conversion materials that most directly relate to toxicological effects. Toxicological endpoints emphasize mutagenic and carcinogenic responses.

29876 (GRI—87/0290, pp 101-134) **Recent developments in direct reduction and reduction smelting.** Feinman, J. (J. Feinman and Associates Inc., Grand Junction, CO (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The latest developments in direct reduction process technology are reviewed with particular emphasis on commercial performance and improvements to increase operating reliability and efficiency. The processes covered include the gas-based ones - Midrex, HyL (fixed and moving bed), FIOR, PLASMARED and The Union Steel Corp. of South Africa process, and the coal-based kiln operations represented by the Scaw Metals Ltd. DRC plant in South Africa. Although none of the reduction-smelting processes such as Korf KR, PLASMASMELT, and the Davy-Mckee integrated process have started commercial operations, their development status is also reviewed because they represent a potentially important extension of DR technology to hot metal production.

0106 Properties

REFER ALSO TO CITATION(S) 29834, 29845, 29853, 29855, 29874, 29875, 29905, 29906, 30733, 30759

29877 (CONF-880604—6) **The application of inverse gas chromatography to coals and oxidized coals.** Neill, P.H.; Winans, R.E. (Argonne National Lab., IL (USA)). 1988. Contract W-31109-ENG-38. 3p.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

In contract to classical gas chromatography, inverse chromatography probes the stationary phase (a coal) by determining the retention time of known compounds on it. The slope of a plot of the log of retention time in 1/T is proportional to retention enthalpy for the probe molecule on the coal. The temperatures at which major slope changes occur, represent points where significant changes in the chemical or physical structure of the coal have occurred. The following coals were analyzed: Upper Freeport, Pocohontas, Bruceton, Illionois No. 6. 4 figs., 2 tabs.

29878 (DOE/PC/70773—10) **Macromolecular structure of low rank coals and lignites: Report for the period January 1, 1988-April 1, 1988.** Larsen, J.W.; Flowers, R.A. II. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 5 May 1988. Contract FG22-84PC70773. 8p.

Objectives of this research are: To investigate and quantitatively characterize the covalent and hydrogen bond crosslinks in sub-bituminous coals and lignites and to determine how they change with coal rank. This study addresses the question of the reactivity of free radicals in coal. Coal samples were extracted with pyridine, dried, then vapor swelled with 4-vinyl pyridine. After swelling samples were weighed then dried again. Spectra were obtained. 14 refs., 4 figs., 2 tabs. (CBS)

29879 (DOE/PC/79806—3) **Characterization and suitability of superclean coals for hydroliquefaction feedstocks: Technical progress report for the period of January 1 to March 31, 1988.** Kim, Nam K. (Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering). 5 Apr 1988. Contract FG22-87PC79806. 26p.

The objective is to evaluate the effect of superclean coals as produced from various domestic coals using MTU's flotation technology on direct coal liquefaction. The micronized and successively clean coals range from 1.0% to 20% in ash content and contain various sulfur concentrations. They are to be assesed as coal conversion feedstocks. Thus, the project will evaluate the effect so ash, sulfur, and ultrafineness of coal feed on the hydroliquefaction process. Pittsburgh No. 8 head coal was hydroliquefied under four different hydrogen pressures (1, 200, 400, and 800 psig). The GC analysis of four liquiefied coals indicated that the initial hydrogen pressure of 500 psig is adequate for the maximum production of compounds having a boiling point that is less than 180 c. As the initial hydrogen pressure is increased, the quantity of high boiling point compounds decreases. Scanning electron micrographs of the four unreacted coal residues showed that the higher hydrogen pressure reacted deeper from the surface, indenting more severely. 9 figs., 5 tabs.

29880 (DOE/PC/80508—4) **Two dimensional and zero field NMR studies of coal structure: Progress report, July 1, 1986-September 31, 1986.** Zilm, K.W. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). Dec 1986. Contract FG22-85PC80508. 9p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007655/JAW.

This report covers the progress made on the use of our unique low temperature CPMAS probe for more quantitative structural analysis of coals by $_{13}C$ CPMAS spectroscopy. We have found that by degassing whole coals and taking their CPMAS spectrum at 77K that a much more quantitative response is obtained. 1 fig.

29881 (DOE/PC/80508—6) Two dimensional and zero field NMR studies of coal structure: Progress report, January 1, 1987-March 31, 1987. Zilm, K.W. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). Dec 1987. Contract FG22-85PC80508. 10p.

This report covers the progress made on exploring a new set of 2D NMR experiments which could potentially be used to determine the connectivity of the various groups in coals. The idea is to use through bond or through space measures of connectivity in solid state NMR analogues of the COSY and NOESY experiments popular in solution NMR. We have investigated a ^{13}C methylated coal and find that ^{13}C-^{13}C NOESY experiments in the solid can be used to establish connectivity between groups in chemically modified coals. 2 figs.

29882 (DOE/PC/80508—7) Two dimensional and zero field NMR studies of coal structure: Progress report, April 1, 1987-June 31, 1987. Zilm, K.W. (Yale Univ., New Haven, CT (USA). Dept. of Chemistry). Dec 1987. Contract FG22-85PC80508. 9p.

This report covers the progress made on exploring some of the limitations of our ADIPSHIFT 2D NMR experiment that we have developed to determine the distribution of functional types of carbon in coals. One of the assumptions made in this methods is that molecular motion in minimal so that the C-H dipolar couplings are not partially averaged out. To investigate this aspect we have measured ADIPSHIFT patterns for paraformaldehyde at room temperature and at 77K and for 2-methyltetrahydrofuran at 77K. The same homonuclear scaling factor is found to fit both room temperature and 77K spectra indicating that motional correction for lattice modes are minimal. Furthermore we find that at 77K we can stop the methyl rotation in 2-methyltetrahydrofuran on the NMR timescale. For coals this implies that nearly any possible motional narrowing problems in the ADIPSHIFT method can be handled by going to 77K operation. 1 fig.

29883 (DOE/PC/80911—T8) Linkages and aromatic clusters in a bituminous coal: Quarterly technical progress report No. 8, June 1, 1987-August 31, 1987. Chung, K.E. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). [1988]. Contract FG22-85PC80911. 10p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006970/JAW.

Objectives of this investiation are: (1) quantitative characterization of a bituminous coal in terms of its major composition and molecular structural characteristics; and (2) a specific examination of aliphatic linkages of the coal. Characterization methodology consists of a controlled depolymerization of a sample coal, solvent extraction of the product, and detailed analysis of the product fractions. For the specific examination of aliphatic linkages, well-characterized soluble fractions from the same coal are investigated by a transalkylation reaction. A molecular model of the Illinois coal was constructed, and product distribution and a minimum hydrogen requirement in the hydroliquefaction of the coal were predicted. During the solubilization reactions with NaOHethanolH_2O, ether groups of the coal were hydrolyzed at 260 to 300{degree}C, and phenolic rings in aromatic lusters were hydrolyzed and opened extensively at 300 to 320{degree}C, leading to the cleavage of aliphatic linkages. Transalkylation reactions of three soluble fractions from the characterization work resulted in high yields of toluene derivatives. Field ionization mass spectroscopy of toluene derivatives showed a high concentration of ditolymethane which was derived from methylene linkages in the feed fractions. Transferred linkages represented only 2.3 to 6.1% of total alkyl linkages in the fractions. Thus, the transalkylation reaction is ineffective for transferring most alkyl groups in the soluble fractions.

29884 (DOE/PC/90507—T6) Surface properties of coal and their role in coal beneficiation: Technical progress report, 15 December 1987-14 March 1988. Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Apr 1988. Contract FG22-86PC90507. 14p.

This ongoing investigation of the surface properties of coal has been aimed at delineating interfacial phenomena related to the flotation cleaning of coal. The major concern of this research has been the investigation of the effects of oxidation on wetting and dewetting phenomena of coal in relation to coal beneficiation. This report details the results from a quantitative FTIR study of the air-oxidation of coal both as a function of oxidation time and oxidation temperature. The results from continued induction time studies and their comparison with film flotation in estimating the critical surface wetting tension are also presented. 8 figs.

29885 (DOE/PC/90521—T5) Role of porosity in supercritical fluid extraction of coal: Technical progress report. Bale, H.D. (North Dakota Univ., Grand Forks (USA)). 15 Mar 1988. Contract FG22-86PC90521. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007117/JAW.

In situ scattering experiemnts have been performed on Wyodak subbituminus coal. We have used tetrahydrofuran, THF, for the extracting fluid which is more satisfactory for the ultraviolet absorption study of the extract. Extraction conditions were: subcritical extraction at 120{degree}C;the effort of pyrolysis in argon preceeding SCE;and progressive isothermal SCE at 380{degree}C. Certain waxy components of the coal are soluble in THF even at low tempertures. The extraction did have an effect on the pore structure, causing a modest increase in the micropore parameters. Pyrolysis in argon alone produced a micropore specific surface of 1.5 x $10^3 m^2 g$;SCE following the pyrolysis 4.0 x $10^3 m^2 g$. Without pyrolysis the micropore surface ws 2.7 x $10^3 m^2 g$. The transition pore specific surface decreased sharply following SCF at 4.5 MPa. Correspondingly the slope of the scattering curve at the smaller h value assumes a value assumes a value of -4. In terms of the pore model, the change in slope is related to the sharp decrease in the transition ,ore structure. Progressive isothermal SCE as a function of pressure was carried out. The curves show a progressive increase in scattering at the intermediate h values which can be attributed to an increase in the transition pore structure. There is also a slight increase in the scattering at the larger h values folowing SCE at 7.5 MPa which suggests additional micropore structure. 2 figs., 2 tabs.

29886 (DOE/PC/90527—T5) Characterization of oxidized coal surfaces: Quarterly report, November 1987-January 1988. Hercules, D.M. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 1988. Contract FG22-86PC90527. 22p.

Work has progressed in the areas of (1) exploration of derivatization reactions for ambient temperature in situ derivatization of phenols, alcohols, and acids on carbon surfaces, (2) analysis of the derivatives by secondary ion mass spectrometry (SIMS), (3) exploration of analysis of known mixtures on carbon surfaces, and (4) initial testing of the reactor for controlled oxidation of coal. Useful results have been obtained with three of the derivatizations. Girard's reagent for positive ion SIMS analysis and 2,4-dinitrophenylhydrazine for negative ion LMS analysis are informative for a wide range of carbonyl compounds. 4-triethylammonium-1-chloro-2-butene (TAB) is highly specific for phenolic compounds in positive ion SIMS analysis if the reaction is performed at high pH and for acids if the reaction is performed at low pH. Analysis on both metal foil and carbon sheets are successful. The use of the carbon support in SIMS analysis is somewhat advantageous in that a good spectrum is obtained, and potentially interfering silver ions are not present. On the basis of the above information, a specific plan for coal analysis has been formulated. The reactor for controlled oxidation of coal was slightly modified, and a sample of Illinois # 6 coal was weathered for 48 hours to test basic ope-ation of the apparatus. 5 refs., 4 figs.

29887 (LA-UR—88-535) Inorganic contents of peats. Raymond, R. Jr.; Bish, D.L.; Cohen, A.D. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 16p. (CONF-880254—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006463/JAW.

From Engineering Foundation conference; Santa Barbara, CA, USA (21 Feb 1988).

Peat, the precursor of coal, is composed primarily of plant components and secondarily of inorganic matter derived from a variety of sources. The elemental, mineralogic, and petrographic composition of a peat is controlled by a combination of both its botanical and depositional environment. Inorganic contents of peats can vary greatly between geographically separated peat bogs as well as vertially and horizontally within an individual bog. Predicting the

form and distribution of inorganic matter in a coal deposit requires understanding the distribution and preservation of inorganic matter in peat-forming environments and diagenetic alterations affecting such material during late-stage peatification and coalification processes. 43 refs., 4 figs., 3 tabs.

29888 **(SAND—87-8802) Automated electron microprobe analysis of coal minerals.** Nissen, D.A.; Greulich, F.A. (Sandia National Labs., Livermore, CA (USA)). Feb 1988. Contract AC04-76DR00789. 22p.

Traditionally, the analysis of mineral matter in coal has involved destruction of the maceral matrix and subsequent determination of the mineral content by X-ray diffraction or wet chemical methods. While such data may be useful for some applications, a great deal of valuable information is irretrievably lost when these methods are employed. Mineral analysis of coal can be done by utilizing the automated scanning capability of the scanning electron microscope coupled with analysis of characteristic X-rays emitted by mineral particles. A systematic study designed to define the limitations of the approach and determine the accuracy and precision of the data has been undertaken. A detailed discussison of the results of this study is the subject of this report. 5 refs., 4 figs., 3 tabs.

0108 Waste Management

REFER ALSO TO CITATION(S) 29835, 29837, 29839, 29858, 29859, 30240

29889 **(DOE/METC—87/6082) Gas stream cleanup papers from DOE/METC-sponsored contractors review meetings in 1987.** Markel, K.E. Jr. (ed.). (USDOE Morgantown Energy Technology Center, WV). Oct 1987. Contract AC21-85MC21353. 356p. (CONF-8704135—Exc.; CONF-870659—Exc.).

From Annual heat engine and gas stream cleanup contractors review meeting; Morgantown, WV, USA (21 Apr 1987).

This document contains gas stream cleanup papers that were presented at two contractors review meetings sponsored by the Morgantown Energy Technology Center of the US Department of Energy in 1987. The two meetings were the Fourth Annual Heat Engines and Gas Stream Cleanup Contractors Review Meeting held on April 21-23, 1987, and the Seventh Annual Gasification and Gas Stream Cleanup Systems Contractors Review Meeting held on June 16-19, 1987. Both meetings were held at the Sheraton Lakeview Conference Center in Morgantown, West Virginia. The purpose of the meetings was to present recent technical information on selected projects in the gasification, heat engines, and gas stream cleanup programs. The meetings provided a forum for the exchange and dissemination of gasification, heat engines, and gas stream cleanup research results generated under the sponsorship of the Department of Energy. The gas steam cleanup program was discussed in combination with the gasification and heat engines programs to emphasize the importance of approaching research on gas stream cleanup concepts from an entire system perspective. Gas stream cleanup is an integral part of all coal conversion technologies. Individual papers have been processed separately for inclusion in the Energy Data Base.

29890 **(DOE/PC/91021—T4) Flue gas cleanup technology utilizing energetic electrons: Technical progress report No. 5, May 6, 1987-August 5, 1987.** Davis, R.H.; Finney, W.C (ed.). (Florida State Univ., Tallahassee (USA). Dept. of Physics). [1988]. Contract AC22-86PC91021. 36p.

The objective of the Electron Beam Precipitator project remains the development of a competitive electron beam precharger for cost-effective and efficient use in conjunction with a collector in a two-stage system for the removal of fly ash from flue gases produced in coal combustion. The research is divided into two categories, Task A which directs the development of precharger design and testing and Task B which calls for the assessment of free electron particle charging. Two important results were obtained during the past quarter. For Task A of the contract, a very high penetration improvement factor (α {equals} 155) was measured with the new Mk. III E-beam precharger at an overall system efficiency of 99.84{percent}, and a collector alone efficiency of 75.4{percent}. The collector voltage was set to produce low corona current which will preclude debilitating back corona. The second important result for Task B is the development of a theoretical model for free electron charging. For one assumption of the particle boundary condition [∞N(a) {equals} 0] the model fit the available data very well, while a second boundary condition [N(a) {equals} 0] predicts even higher charge values which might be achievable if the present results are limited by trace impurities. The progress made on both tasks is briefly summarized in this report. 15 figs., 1 tab.

29891 **(DOE/PC/91101—T6) Sulfur dioxide removal from flue gases by supported copper and iron absorbents: Technical report No. 6, November 16, 1987-February 15, 1988.** Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). 1988. Contract FG22-86PC91101. 10p.

Significant progress has been achieved on the preparation, characterization and evaluation of $CuAl_2O_3$ sorbents for SO_2 sorption. By using the extraction technique, sorbents have been prepared that contain copper incorporated into the alumina support without any copper {open quotes}flakes{close quotes} adhering to the surface as is routinely found in sorbents prepared by using aqueous impregnation techniques. The $CuAl_2O_3$EX sorbents are effective for SO_2 sorption step, which includes the irreversible uptake of SO_2, the $CuAl_2O_3$EX sorbents feversibly take up SO_2 which is reproducible over several sorptionregeneration cycles. 5 figs.

29892 **(ORNL/TM—10753) Laboratory testing of a fluidized bed dry scrubbing process for removal of sulfur dioxide and phosphoruous pentoxide from an inert carrier gas: Final report.** Bradshaw, W.M. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 51p. (AMXTH-TE-CR—88008).

It is feasible to remove P_2O_5 and SO_2 in a fluidized bed consisting of calcium oxide operating in a bubbling bed regime at 540{degree}C (1000{degree}F). No adverse "coeffects" between P_2O_5 and SO_2 exist when they are scrubbed simultaneously. Of the parameters considered, gas velocity had the most significant effect on efficiency of P_2O_5 removal, probably because vigorous bubbling in the bed resulted in better solid-gas contacting. The removal efficency is greater at 3.5 times the minimum fluidization velocity than at 1.8 times the minimum fluidization velocity. Removval efficiency for P_2O_5 increases with temperature, probably because of an increase in the reaction rate constant. The removal efficiency is slightly greater at 540{degree}C (1000{degree}F) than at 480{degree}C (900{degree}F) (i.e., 99.8 vs 99.7%). 9 refs., 4 figs., 1 tab.

29893 **(PB—88-180674/XAB) Oxidative degradation of organic acids conjugated with sulfite oxidation in flue-gas desulfurization. Final report, June 1984-June 1986.** Lee, Y.J.; Rochelle, G.T. (Texas Univ., Austin (USA). Dept. of Chemical Engineering). Feb 1988. 173p. NTIS, PC A08/MF A01.

This report gives results of a study of organic acid-degradation conjugated with sulfite oxidation under flue-gas desulfurization (FGD) conditions. The oxidative degradation constant, k12, is defined as the ratio of organic-acid degradation rate and sulfite oxidation-rate times the ratio of the concentrations of dissolved S(IV) and organic acid. It is not significantly affected by pH or dissolved oxygen in the absence of Mn or Fe. However, k12 is increased by certain transition metals such as Fe, Co, and Ni and is decreased by Mn and halides. Lower dissolved S(IV) magnifies these effects. A free-radical mechanism was proposed to describe the kinetics. Hydroxy and sulfonated carboxylic acids degrade approximately three times slower than saturated dicarboxylic acids; while maleic acid, an unsaturated dicarboxylic acid, degraded an order of magnitude faster. A wide spectrum of degradation products of adipic acid were found, including carbon dioxide (the major product), smaller dicarboxylic acids, monocarboxylic acids, other carbonyl compounds, and hydrocarbons.

29894 **(PB—88-861851/XAB) Fly ash. April 1985-March 1988 (Citations from the NTIS data base). Report for April 1985-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 123p. NTIS PC N01/MF N01.

Supersedes PB—87-856399.

This bibliography contains citations concerning the collection, disposal, and utilization of fly ash. Topics include chemical behavior and composition studies, potential environmental effects, toxicity determinations, management strategies, and materials-recovery programs. The employment of fly ash as a cement replacement, and highway construction material is discussed. (This updated bibliography contains 228 citations, 84 of which are new entries to the previous edition.)

29895 **Interaction of SO_2 with copper and copper oxide surfaces.** Baxter, J.P.; Grunze, M.; Kong, C.W. (Laboratory for Surface Science and Technology and Department of Physics and Astronomy, University of Maine, Orono, Maine 04469). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1123-1127(May 1988).

The adsorption and reaction of SO_2 with copper and copper oxide surfaces was studied by in situ x-ray photoelectron spectroscopy between 173 and 473 K and pressures ranging from UHV to 10^{-1} mbar. It was found that a Cu_2SO_3 species acts as an intermediate in the formation of $CuSO_4$ at $T<300$ K, and at $T>300$ K in the formation of copper sulfide. The presence of gas-phase oxygen was found to accelerate the surface reaction between SO_2 and the substrates. In this communication we will focus on the experiments on Cu_2O surfaces and discuss our results in the context of the SO_2—flue-gas cleanup process on copper oxide.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 29837, 29844, 29889, 29890, 29915, 31113, 31278

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 29833, 29887

0120 Mining

REFER ALSO TO CITATION(S) 31278

29896 **(PB—88-181946/XAB) Spalling and the development of a hydraulic-fracturing strategy for coal. Semiannual report, February-July 1987.** Bell, G.J.; Jones, A.H.; Morales, R.H. (Terra Tek, Inc., Salt Lake City, UT (USA)). Aug 1987. 112p. (TR—88-19). NTIS, PC A06/MF A01.

Coal failures play an important role in fracture-propagation behavior in coal beds. The focus of this research is to gather evidence in support of this concept or to identify other fundamental mechanisms that may be in force, and to apply the knowledge to the design of optimal stimulation treatments for coal. Samples recovered from two eastern U.S. coal mines were characterized with regard to their compressive strength and chemical makeup. When compared with results from other sources, it was established that a correlation exists between these parameters, where the highest-rank, gassy coals tend to be the weakest ones encountered. Stimulations conducted at three wells in the Oak Grove Field of the Warrior Basin, Alabama by Taurus Exploration, Inc. were monitored.

0130 Transport And Handling

29897 (CONF-8605117—, pp 107-119) **Pilot scale preparation of lignite and subbituminous coal/water fuels.** Potas, T.A.; Baker, G.G.; Maas, D.J.; Farnum, S.A.;. (Univ. of North Dakota Energy Research Center, Grand Forks (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

The majority of today's coal/water slurry technology has been developed to prepare a high energy liquid fuel from bituminous coals. Low-rank coals, mostly because of their high inherent moisture contents, produce a lower energy density slurry fuel when mixed with water and can not be economically utilized. However, the energy density of low-rank coals in slurry can be dramatically improved with hydrothermal treatment. This process results in the coal being essentially slurried in its own initial moisture and results in a liquid fuel having approximately the same heating value as the parent coal. The elevated temperatures of the process also cause low-rank coals to undergo both chemical and physical changes, which, depending on process severity, may include decarboxylation, mild pyrolysis, extraction, dehydration and surface modification. As a result, lignite and subbituminous coals acquire surface characteristics and improved coal quality which greatly enhance their usefulness in preparing concentrated coal/water slurry fuels. The University of North Dakota Energy Research Center (UNDERC) has been developing a hydrothermal low-rank coal treatment process since 1983. A continuous Process Development Unit (PDU) to produce 2.5 tons of slurry per day has been built and operated to demonstrate the technical feasibility of the process and to generate data useful in engineering and economic studies. This paper describes the effects of process temperature on the properties of low-rank coal/water fuels prepared by the hydrothermal-treatment procedure.

29898 (CONF-8605117—, pp 120-125) **Heat transfer in coal water slurry flow.** Irdam, E.; Hasan, A.R. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Heat transfer in coal-water slurries flow was studied using a horizontal pipe heat transfer loop that is electrically heated by a DC power supply unit. Coal slurries were prepared from Beulah and Rosebud coal with mean particle diameter sizes of 43 and 52 microns. Heat transfer data were gathered with slurries containing 10% to 50% solids and flow rates ranging between 0.44 to 0.86 lb/second. The heat transfer data gathered were then correlated using a modified Dittus-Boelter equation. These dimensionless numbers were calculated using the rheological indices for each slurry and were determined using two flow behavior model: Power Law and Yield Power Law models. The Rheogram was prepared from data gathered using a Haake RV-100 Rotational Viscometer.

29899 (CONF-8605117—, pp 137A) **Effects of various drying methods on rheology of low rank coal-water slurries.** Baria, D.N.; Hasan, A.R. (Univ. of Minnesota, Duluth (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the processes and results of test burns using low rank lignite and subbituminous coal from Texas, North Dakota, and Wyoming. The rheology of the coal-water slurries prepared using the as received and dried coals was studied using an extrusion-type capillary viscometer at 27.8°C. The rheological properties of the slurries prepared using the as received coal were compared to those of slurries prepared using Parry entrainment dried, steam dried, and hot water dried coals. In conclusion, it can be stated that steam and hot water dried low rank coals can be used for preparation of coal-water slurries which exhibit significantly superior rheological properties compared to those for slurries prepared using the as received Parry dried coal. Test procedures and descriptions are provided.

29900 (CONF-8605117—, pp 138-144) **Dry materials flow measurement experiments at the CDIF.** Karvinen, R. (MSE, Inc., Butte, MT (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Flow rate measurement in a solid-gas mixture has been the subject of many studies. The one overriding conclusion is that any solid-gas mixture will flow smoothly over a narrow range that lies somewhere between slugging and plugging. The difficulty is to make the desired flow fall within this range. Various vessel feed

and piping arrangements were attempted at the component development and integration facility (CDIF) to obtain smooth, measurable flow rates when flowing coal and nitrogen. The varying test results from these attempts are reported in this paper. At the time of this writing, measurable coal flows in the desired range were not attained using unrecycled, newly prepared coal. However, after several recycles of the coal, smooth flows could be measured over the desired range. Original coal sample analysis did not show appreciable change in the coal characteristics, although experience indicated that the coal should be smoother and smaller with recycling.

29901 **(DOE/PC/90518—T4) Aerated and vibrated chute feeders for particulate materials: Quarterly technical report for the period December 1, 1987 to February 29, 1988.** Jackson, R.; Nott, P.R. (Princeton Univ., NJ (USA). Dept. of Chemical Engineering). 1988. Contract FG22-86PC90518. 10p.

In our efforts to understand the flow of particulate materials and to investigate efficient methods for their transportation, our approach has been theoretical as well as experimental. On the theoretical side, we had formulated the relevant differential equations that govern the motion of these systems and derived the boundary conditions at solid boundaries and free surfaces {endash} we have solved these equations for the case of gravity driven flow of particulate materials in inclined chutes. On the experimental side, we have constructed a chute-flow apparatus, in which we have made measurements for unaerated flows {endash} we are in the process of modifying the apparatus to study the effect of aeration. We assume that the particle and fluid phases act as separate but interpenetrating continua, and that their respective dynamics are coupled by fluid-particle interactions. Our constitutive theory for the particle-particle interactions is a combination of the so-called "fractional" contribution, "collisional" contribution, and the "kinetic" contribution. The frictional stress contributions are described by critical-state constitutive theory, which collisional constitutive relations, which depend on the "grain-temperature", T (a measure of the random kinetic energy), the solid volume fraction, v, and the deformation rate account for the collisional-kinetic stress contributions. We use a combination of the Ergun and Richardson-Zaki equations to predict the fluid-particle drag. 10 refs., 5 figs., 2 tabs.

0140 Combustion

REFER ALSO TO CITATION(S) 29833, 29839, 29899, 29988

29902 **(CONF-871113—6) Hydrodynamics of erosion of heat exchanger tubes in fluidized bed combustors.** Bouillard, J.X.;Lyczkowski, R.W.;Folga, S.;Gidaspow, D.;Berry, G.F. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 39p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88005974/JAW.

From American Institute of Chemical Engineers annual meeting; New York, NY, USA (15 Nov 1987).

The hydrodynamics of fluidization for two thin "two-dimensional" fluidized beds, one containing a centrally located rectangular obstacle and the other containing three square tubes roughly approximating a portion of a fluidized bed combustor (FBC), was solved using the FLUFIX/MOD2 computer program. The monolayer energy dissipation erosion model extended to include solids viscous stress was compared with the Finnie erosion model. Hydrodynamic and erosion convergence studies were performed for the first bed. Computed erosion rates from the monolayer energy dissipation erosion model compare more favorably for both beds with available erosion data than those from the Finnie erosion model. 27 refs., 15 figs.

29903 **(CONF-8710300—1) Corrosion of heat exchanger materials in the presence of FBC [fluidized-bed combustion] deposits.** Natesan, K. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 26p.

From Symposium on materials performance in fluidized-bed combustion environments; Cincinnati, OH, USA (12 Oct 1987).

Metallic materials selected for the construction of in-bed heat exchangers and tube support structures in fluidized-bed combustion (FBC) systems must withstand the corrosive conditions prevalent in these systems. Laboratory tests were conducted to examine the role of deposit chemistry, gas chemistry, and alloy pretreatment in the oxidation-sulfidation behavior of Incoloy 800 specimens at a test temperature of 840{degree}C. Four reagent grade deposit mixtures and two spent-bed materials (from TVA and Grimethorpe) were used in the program. Results are presented on the microstructural characteristics of scale layers that developed in the presence of different deposit mixtures. Preformed oxide scales were to be found resistant to sufldiation attack in the presence of the deposit mixture. Precarburization of a the alloy, which results in a lower Cr activity in the austenite phase of the alloy, caused significant sulfidation of the alloy. The study showed that both deposit composition and the gas phase environment play signficant roles in the development of protective oxide scales on alloy surfaces. 4 refs., 10 figs., 1 tab.

29904 **(DOE/PC/70775—8) Synthetic chars for studies of char combustion mechanisms: Quarterly technical progress report, June 1, 1986-August 31, 1986.** (California Inst. of Tech., Pasadena (USA)). [1988]. Contract FG22-84PC70775. 3p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007780/JAW.

This project focuses on the development of synthetic chars with controlled pore structure, composition, and particle size for the study of the fundamental mechanisms of char oxidation in the char burnout phase of coal combustion. Initial combustion experiments had indicated that there was more variability in the structure particles than had been desired or expected. Microscopic examination of the particles revealed small pits on the surfaces of about 10% of the carbon spheres, suggesting that there were differences in the porous microstructures of the particles. Efforts focussed on improving the particle generation system to eliminate the sources of this variability. 1 fig.

29905 **(DOE/PC/70775—10) Synthetic chars for studies of char combustion mechanisms: Quarterly technical progress report, December 1, 1986-February 28, 1987.** (California Inst. of Tech., Pasadena (USA)). [1988]. Contract FG22-84PC70775. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007782/JAW.

Synthetic char particles of uniform size and a variety of porous microstructures wre geerated by atomization of solutions or suspensions of a polymer of furfuryl alcohol in acetone with added pore formers. Several types of particle swere generated and characterized. BET surface areas of the various chars are also reported. Surace areas are seen to vary by more than two orders of magnitude, with the carbon black containing material being by far the highest. Chars were burned in a drop tube furnace to examine the role of the porous microstructure on the oxidation kinetics. Material with carbon black was most reactive, attributed to enhanced oxygen diffusion due to the transitional pore network.

29906 **(DOE/PC/70775—14) Synthetic chars for studies of char combustion mechanisms: Quarterly technical progress report, December 1, 1987-February 28, 1988.** (California Inst. of Tech., Pasadena (USA)). [1988]. Contract FG22-84PC70775. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007786/JAW.

This project focuses on the development of synthetic chars with controlled pore structure, composition, and particle size for the study of the fundamental mechanisms of char oxidation in the char burnout phase of coal combustion. Efforts were made to incorporate inorganic materials into the carbon matrix of the chars. Calcium was added to the carbon particles by a variety of methods: (1) ion exchange; (2) precipitation; and (3) calcium acetate impregnation. The addition of calcium to a mineral-free carbon matrix makes possible the study of the behavior of the calcium additive during combustion and any influence of the calcium on the combustion behavior with a minimum of ambiguity. The effectivness of the calcium dispersion within the carbon particles was examined by scanning of sectioned particles. A CamScan scanning electron microscope and a Jeol Superprobe 733 microprobe were used to measure the Calcium concentration as a function of distance from the particle surface. 2 refs., 9 figs.

29907 (DOE/PC/80263—7) Investigation of the combustion properties of micronized coal: Technical progress report for the period January 1, 1987-March 31, 1987. Freihaut, J.D.; Vranos, A.; Proscia, W.M.; Knight, B. (United Technologies Corp., East Hartford, CT (USA)). 1987. Contract AC22-85PC80263. 21p.

The combustion sequence of small coal particles in high intensity combustors is presented. In general, high volatile bituminous coal particles burn in two stages - a volatiles combustion phase and a char burnout phase, each with its own characteristics time. The volatiles combustion phase resembles a heavy fuel oil combustion process. In this process, the generation of heavy hydrocarbon vapors in the gas phase surrounding the particle is primarily determined by the rate of heat transfer to the particle surface. The primary concern of this investigation is detailing the fate of the fuel bound nitrogen, sulfur and colloidal mineral matter during this stage of combustion. 14 figs., 2 tabs.

29908 (DOE/PC/80263—8) Investigation of the combustion properties of micronized coal: Technical progress report for the period April 1, 1987-June 30, 1987. Freihaut, J.D.; Vranos, A.; Proscia, W.M.; Knight, B. (United Technologies Research Center, East Hartford, CT (USA)). 1987. Contract AC22-85PC80263. 17p.

One of the objectives of this investigation is to develop an understanding of centrifugally driven gas mixing phenomena and mixing of particle-gas flows. A novel mixing technique utilizing centifugally driven instabilities has been studied using the centrifugal mixing combustor (CMC). The CMC uses a cold (high-density) swirling inner flow and a hot (low-density) non-swirling outer annular flow with velocity levels chosen to trigger the instability. Hot film anemometry and planar digital imaging flow visualization have been used to study the gas phase mixing. The digital imaging technique utilizes sub-micron particles (diffusion pump oil) to seed the inner flow. These extremely small particles faithfully track the fluid streamlines in the swirling flow. 9 refs., 9 figs.

29909 (DOE/PC/80263—9) Investigation of the combustion properties of micronized coal: Technical progress report for the period July 1, 1987-September 30, 1987. Freihaut, J.D.; Vranos, A.; Proscia, W.M.; Knight, B. (United Technologies Corp., East Hartford, CT (USA)). 1987. Contract AC22-85PC80263. 18p.

Velocity profiles were obtained in the Centrifugal Mixing Combustor using a slant-film sensor and constant temperature aneomometer. The technique of utilizing a single slant-film sensor to measure three velocity components has been published, and involves measuring the response of the sensor at six angles and reducing the measurements into velocity components by solving three algebraic equations. The velocity data was obtained in cold flow, with a 45 degree Free-Vortex swirler in the inner flow. Plots of the data are included with this report. Average temperature profiles were obtained for three velocity levels and three types of flames: (1) Simple mixing, (2) Premixed flame, and (3) Diffusion flame. Gaseous propane was utilized as the test fuel. In all cases, the outer flow velocity was maintained at a constant 1.57 m/sec. For the diffusion flame test, the outer pilot flow was operated fuel-rich with no fuel in the inner flow. Velocity and temperature profiles show that the negative density gradient provided by the centrifugal mixing combustor during combustion tests results in enhanced mixing when compared to uniform density cold flow mixing. The mixing is so intense that the temperature profiles are uniform within 1.5 swirler diameters downstream of the swirler exit. The distance required for complete mixing is reduced by 60{percent} when utilizing the centrifugal mixing concept. 14 figs.

29910 (DOE/PC/80263—10) Investigation of the combustion properties of micronized coal: Technical progress report for the period October 1, 1987-December 31, 1987. Freihaut, J.D.; Vranos, A.; Proscia, W.M.; Knight, B. (United Technologies Corp., East Hartford, CT (USA)). 1987. Contract AC22-85PC80263. 9p.

High-frequency response thermometry was conducted on the Centrifugal Mixing Combustor for three types of flame configurations at three velocity levels. A 45 degree Free Vortex swirler was utilized in the inner flow, with a solid centerbody along the combustor axis to reduce recirculation. The time constant of these thermocouples was measured experimentally. The thermocouples were heated above the air stream temperature using a 30kHz AC signal. A high speed switching system was used to trigger a digital signal analyzer at the precise moment that the heating current was interrupted to the thermocouple. The output of the thermocouple as the wire cooled to ambient temperature was recorded, and the time constant determined from the decay curve. The three configurations studied exhibited some common features which seem to depend upon fluid mechanics independent of combustion. For simple mixing, the correlation coefficient was high in the recirculation zone and low at the edge of the shear layer for the high velocity flow. For the low velocity flow, the situation was reversed. The measurements suggest a more highly defined recirculation zone at the high velocity. The number of lobes multiplies at the interface between the two flows. The premixed flame was characterized by high coherence levels across the mixing layer at low velocity, and loss of coherence at high velocity. Frequency doubling was found in the recirculation zone and near the pilot interface at the low velocity. For the diffusion flame, the behavior is similar to that of simple mixing except for the frequency division at the higher velocity in the recirculation zone. The frequency which contains the greatest energy in the centrifugal mixing combustor (CMC) is in the 1-1.5 kHz band in general. This corresponds well with particle trajectory calculations which indicate that particles in the 40 micron range can follow the gas streamlines in the inertial fields expected in this type of combustion system. 4 figs.

29911 (DOE/PC/80263—11) Investigation of the combustion properties of micronized coal: Technical progress report for the period January 1, 1988-March 31, 1988. Freihaut, J.D.; Vranos, A.; Proscia, W.M.; Knight, B. (United Technologies Corp., East Hartford, CT (USA)). 1988. Contract AC22-85PC80263. 22p.

Planar digital imaging is a non-intrusive method of obtaining the concentration of one gas or liquid within another gas or liquid in a two dimensional plane. The fluid of interest is seeded with particles which are illuminated by a thin sheet of laser light, and the resulting Mie-scattered light is collected on a photodiode array known as a vidicon. The vidicon is scanned, and digitized, and the resulting array can be processed into a two-dimensional map of the concentration of the seeded flow in the area being viewed. By normalizing the digitized output to a known concentration of seeded flow, usually mole fraction of 1 (pure seeded fluid), a concentration map can be generated. The data can be displayed as a false color image where a particular concentration level is assigned a particular color, or contours of constant mole fraction can be displayed. The figure enclosed shows the main elements of the digital imaging system. A rotating mirror is used to create a light sheet which is typically 1mm thick. The velocity of the rotating light beam is 4800 m/sec, which is sufficient to freeze all motion of the particles during the exposure time which is typically 35 microseconds. 12 figs.

29912 DOE, Kentucky to examine fluidized bed obstacles. *Fossil Energy Review;* 9(Jan-Feb 1988).

DOE has joined the Commonwealth of Kentucky in a $118,000, 21-month long study of the impediments to atmospheric fluidized bed coal combustion in the industrial sector. The study will be carried out under an annex signed on February 16. The annex is part of an agreement signed by Kentucky and DOE in August 1987. Fluidized bed technology has been proven to be an economical, clean method of burning coal in the large industrial boiler market. Yet only two out of 800 industrial boilers in Kentucky use this technology. The joint study will attempt to pinpoint barriers that have impeded the technology and recommend alternatives to help eliminate or mitigate them.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 29946, 30402, 30435, 30438

29913 (GRI—87/0290, pp 15-20) **Supply, demand, and price structure for coke.** Terchick, A.A. (USX Corp., Monroeville, PA (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

From 1978 to 1986 hot-metal production decreased from 83.6 to 44.0 million tons or a decrease of about 47%. During the period from 1978 to 1985 the coke production also decreased 47% from 45.1 to 23.9 million tons, indicating the decrease in coke production can be attributed to hot-metal demand as well as the condition of the batteries. Since many of the batteries that have been shut down could be restarted and the coke-production capability can supply the coke to meet the demand for hot-metal production there should not be a coke shortage until after the mid 1990's. With an excess in coke capacity and metallurgical coal, the price for metallurgical coke should also remain relatively stable until sometime after the mid 1990's.

29914 (ORNL/tr—88/7) **Optimum briquette pricing policy and reasonable pricing system.** Kim, Zin-oh; Kim, Zin-woo; Loh, Jae-sun. (Oak Ridge National Lab., TN (USA)). 1981. Contract AC05-84OR21400. Translation source information not available . 76p.

Major issues of domestic anthracite Coal production and Consumption are analyzed. Anthracite Coal is the only domestic fossil fuel resource in Korea and the major fuel source for residential sector. The pricing of anthracite coal is the major policy issue in the field of energy policy in Korea. Policy goals of pricing after conflict: high price of coal will encourage the production but will hurt the general public by causing inflation. The government has been keeping the price of anthracite coal low in the market while subsidizing the coal industry. This has contributed to both promotion of coal production and protection of the general public from inflation. The low prices and government subsidization, however have encouraged wasteful use of coal, rather than promote increased production of coal as much as a high price policy could have. To encourage the production of coal after the 1973 oil shock. The Government raised coal price. Despite the price increases, selling price has never exceeded production costs and costs have continued to increase steadily. 57 refs., 1 fig., 22 tabs.

0160 Health And Safety

REFER ALSO TO CITATION(S) 31278

29915 **Coal conversion: reconciling technology development and health and environmental concerns.** Gray, R.H. (Battelle Northwest Labs., Richland, WA (USA)). pp 383-392 of Focus on Alaska's coal '86. Rao, P.D. (ed.). Fairbanks, AK; Univ. of Alaska (1986). (CONF-861071—). Contract AC06-76RL01830.

From Focus on Alaska's coal '86; Anchorage, AK, USA (27 Oct 1986).

Over the past decade, a chemical and toxicological data base was developed to aid engineers in the design of safe processes to convert coal to liquid fuels. Objectives of this effort were to: identify and evaluate long-term health and environmental issues; evaluate options to permit environmentally acceptable design and operation; and assess risk to man and the environment from deployment of a large-scale coal conversion industry. Full-boiling-range coal-derived liquids were generally more active than shale oil and petroleum crudes in toxicological test systems. Toxicologically-active agents included polynuclear aromatic hydrocarbons (PAH), amino-PAH, phenolics, and others. Some components of coal-derived materials were taken up by biota and metabolized. Hydrotreating (a refining or upgrading process) reduced the concentrations of amino-PAH, PAH, and phenol, as well as toxicological response to coal liquids. Selective distillation restricted amino-PAH and PAH content as well as mutagenicity and carcinogenicity to high-boiling-range materials. The data base described provides input for assessment and has been used by developers to select process modifications and product slates that minimize risk to man and the environment. These data have also been used to develop occupational health and industrial hygiene practices and may aid selection of control technologies, mitigative strategies, special handling, and accident prevention procedures or spill-cleanup options to enhance the environmental acceptability of a coal-conversion industry. 27 references, 7 figures, 2 tables.

02 PETROLEUM

0201 Reserves

REFER ALSO TO CITATION(S) 29926, 29927, 29928, 29929, 29930

29916 (CONF-8605117—, pp 29-30) **Where is Hubbert's pimple in 1986.** Gosnold, W.D. Jr. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the works of M. King Hubbert, a US Geological Survey geophysicist. It describes his predictions on the rise and decline of petroleum exploration, development, and exploitation. According to his graphs and mathematical calculations the worlds petroleum supplies would peak and then decline even as more discoveries came to light. His predictions are coming true with frightening ramifications for the US who is dependent on this energy resource. It goes on to make recommendations to possible energy alternatives and why secondary and tertiary oil recovery is not a solution.

29917 **DOE picks Colorado petroleum engineering firm to update crude oil estimates at Elk Hills.** *Fossil Energy Review;* 13(Jan-Feb 1988).

The Department of Energy has selected a Golden, Col.-based petroleum engineering firm to update estimates of the recoverable crude oil in the Elk Hills Naval petroleum Reserves No.1, in Kern County, California. The contract represents the first comprehensive analysis done of the crude oil remaining in the 48,000 acre oil field. Previously, reserve estimates had been done on individual zones within the reservoir. Based on those estimates, the Energy Department reported in its fiscal 1986 annual report that Elk Hills contained just over 670 million barrels of recoverable reserves. Under a 1944 agreement with Chevron Corp., the government owns approximately 78% of the recoverable reserves. The first phase of the study will develop an understanding of current reservoir data and prior studies and result in new geologic models of estimated oil and gas reserves. The second phase will provide revised estimates of the original oil and gas in each zone of the reservoir and assess the effects of past production and operations. The third phase will establish the economic potential of the field. At the end of the third phase, a fourth task may be exercised with options to provide additional reservoir engineering analysis to corroborate assumptions used in the first three phases.

0202 Geology And Exploration

REFER ALSO TO CITATION(S) 29926, 29927, 29928, 29929, 29930

29918 (PB—88-168836/XAB) **Gulf of Mexico continental slope study annual report, year 2.** (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Sep 1986. 605p. NTIS, PC E99.

Set includes PB—88-168844 through PB—88-168869.

A separate abstract was prepared for the three volumes of this set.

29919 (PB—88-168844/XAB) **Gulf of Mexico continental slope study annual report, year 2. Volume 1. Executive summary.** (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Sep 1986. 31p. NTIS, PC A03/MF A01.

See also Volume 2, PB—88-168851; Also available in set of 3 reports PC E99, PB—88-168836.

This report summarizes the data management and scientific analyses accomplished during the first two years of a multiyear joint LGL Ecological Research Associates/Texas A&M University study of the continental slope of the northern Gulf of Mexico, which was initiated in 1983 by the Gulf of Mexico Regional Office of Minerals Management Service (MMS). The study when completed will be based upon five cruises. The original delineation of objectives established for the project was compatible with the environmental responsibility of MMS to control, in the Gulf of Mexico, the development of hydrocarbons in time and space within the geographic purview of the Regional Office. To do this, the Service would have to gain knowledge of what biological and other valuable resources are present on the slope and thus are vulnerable to inevitable impacts of petroleum development.

29920 **(PB—88-168851/XAB) Gulf of Mexico continental slope study annual report, year 2. Volume 2. Primary volume. Interim report 1985-1986.** (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Sep 1986. 242p. NTIS, PC A11/MF A01.

See also Volume 1, PB—88-168844 and Volume 3, PB—88-168869; Also available in set of 3 reports PC E99, PB—88-168836.

This report, which was prepared in three volumes (Executive Summary, Primary Volume, and Appendix), details the findings of two years of sampling on the continental slope of the northern Gulf of Mexico at depths of 300-3000 m. Preliminary results from a third year of sampling are also presented. Physical and chemical measurements included: CTD casts at 35 stations; sediment characteristics, including hydrocarbons and bulk sediment parameters from 60 stations; tissue hydrocarbon levels of representative benthic organisms; and delta carbon-13 values from sediments and organisms, including comparison of areas of natural petroleum seepage to prevailing slope conditions. The biological oceanography section provides detailed enumeration of megafaunal specimens collected by trawling and of macro- and meiofaunal specimens collected with a 600 sq cm box core. Major megafaunal groups treated are Arthropoda, Echinodermata, and demersal fishes.

29921 **(PB—88-168869/XAB) Gulf of Mexico continental slope study annual report, year 2. Volume 3. appendices. Interim report, 1985-1986.** (LGL Ecological Research Associates, Inc., Bryan, TX (USA)). Sep 1986. 332p. NTIS, PC A15/MF A01.

This report, which was prepared in three volumes (Executive Summary, Primary Volume, and Appendix), details the findings of two years of sampling on the continental slope of the northern Gulf of Mexico at depths from 300-3000 m. Preliminary results from a third year of sampling are also presented. Physical and chemical measurements included: CTD casts at 35 stations; sediment characteristics, including hydrocarbons and bulk sediment parameters from 60 stations; tissue hydrocarbon levels of representative benthic organisms; and delta carbon-13 values from sediments and organisms, including comparison of areas of natural petroleum seepage to prevailing slope conditions. The biological oceanography section provides detailed enumeration of megafaunal specimens collected by trawling and of macro- and meiofaunal specimens collected with a 600 sq cm box core.

29922 **(PB—88-183090/XAB) Study of biological processes on the US mid-Atlantic Slope and rise. Volume 2. Final report, Report. for March 1984-March 1986.** Maciolek, N.; Grassle, J.F.; Hecker, B.; Boehm, P.D.; Brown, B. (Battelle Ocean Sciences, Duxbury, MA (USA)). 15 Dec 1987. 473p. NTIS, PC A20/MF A01.

See also PB—87-214359 and PB—88-182845.

Box core samples were collected at 14 stations as part of a monitoring program to evaluate potential effects of exploratory drilling in water depths of 1500 and 2100 m. The box core samples were analyzed for benthic infauna, hydrocarbons, sediment grain size, and total organic carbon, hydrogen, and nitrogen. Benthic infaunal diversity was high at all stations on all sampling dates. As a group, the shallower (1515-1613 m) stations were more diverse than the deeper stations. Species composition and abundance was homogeneous at depths of 2020 to 2195 m along a 176-km transect. Changes in diversity or similarity among stations over time could be explained by changes in the densities of a few dominant species, and were often related to differences in sediment texture, rather than drilling activities.

29923 **Organic geochemistry of marine sediments in Antarctic region: marine lipids in McMurdo Sound.** Venkatesan, M.I. (Univ. of California, Los Angeles, (USA)). *Organic Geochemistry;* **12**: No. 1, 13-27(1988). Contract AS03-76EV70134.

The compositions of resolvable lipid components from four sediment cores (0-90 cm) of McMurdo Sound, Ross Sea, have been examined. The various lipid components occur in the following order of abundance: sterols $\approx$ n-fatty acids > n-alcohols > n-alkanes > PAH. The data indicate that the organic matter is mainly derived from recycled kerogen mixed with modern marine input. The distribution of lipids and lignin analyses indicate that there is little recognizable higher plant debris in the sediments. The sediments contain unaltered biogenic triterpenoids, and there is no evidence for natural and/or anthropogenic petroleum influx in the region. Aeolian transport of organic carbon from the continents appears to be negligible. The dominance of labile alkenes (C_{28} compounds) and hopenes and the presence of unsaturated fatty acids down to a depth of 90 cm reflect a very early diagenetic stage. The persistent cold climate has probably helped in the better preservation of these labile lipids in the water column and in the young sediments. Diploptene (17β(H),21β(H)-hop-22(29)-ene) appears to originate from autochthonous marine productivity in McMurdo Sound. 111 references.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 31486

29924 **(DOE/BC—87/2) Contracts for field projects and supporting research in enhanced oil recovery: Progress review No. 50, quarter ending March 31, 1987.** (USDOE Assistant Secretary for Fossil Energy, Washington, DC. Office of Oil, Gas and Shale Technology; USDOE Bartlesville Project Office, OK). Mar 1988. 134p.

Research programs on various methods of enhanced recovery are described. Programs include work in carbon dioxide injection, caustic flooding, microemulsion flooding, in-situ combustion, fluid injection, the use of surfactants, adsorption measurements, oil saturation, thermal recovery, resource assessment technology, and microbial technology.

29925 **(DOE/BC/10848—10) Adsorption from flooding solutions in porous media: Second annual report, October 1986-October 1987.** Somasundaran, P.; Bell, R.; Boyd, J.; Chandar, P.; Fu, E.; Huang, Y.; Ramachandran, R.; Pereira, V.; Sivakumar, A.; Snell, E.; Velosa, A.; Viswanathan, K.V. (Columbia Univ., New York (USA). School of Engineering and Applied Science). Mar 1988. Contract AC19-85BC10848. 107p.

Surfactant formulations that are used in enhanced oil recovery consist of mixtures of various components. We have continued studies on mixtures of an anionic surfactant, C_8benzenesulfonate, and a nonionic surfactantt. $C_{12}EO_3$alcohol. Adsorption data on alumina and silica show that strong interactions between the two surfactants occur. On alumina on which the nonionic does not absorb by itself the presence of small amounts of adsorbed sulfonate was sufficient to cause significant adsorption of ethoxylated alcohol. On silica sulfonate did not absorb by itself but only did so in the presence of alcohol. Interactions between surfactants were quantified using the regular mixing model. Interaction parameters between -3 and -5 were determined at the liquidair interface in mixed micelles from surface tension data for different surfactant compositions. Work is focused on directly measuring thermodynamic quantities using microcalorimetry. Surfactant structural effects were also studied. A series of branched C_{14}benezenesulfonates emphasizes characterization along with adsorption measurements. Results showed major influences in addition to that of chain lenth and chain branching due to the position in the benzene ring of the longer alkyl chain in relation to that of the sulfonate group. 43 refs., 54 figs., 3 tabs.

29926 **(DOE/FE/60600—T17-App.1) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General Reservoir Study:.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 01 Sep 1987. Contract AC01-85FE60600. 456p.

This study, Appendix I, addresses the Bittium Sands and its sub units and pools. Basic pressure, production and assorted technical data were provided by the US Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evanc, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoirs. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can now additionally serve as a take off point for exploitation engineers to develop specific programs toward the end. 21 figs., 9 tabs.

29927 **(DOE/FE/60600—T17-App.3) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General reservoir study, Appendix 3, Second Wilhelm Sand.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 1 Sep 1987. Contract AC01-85FE60600. 407p. NTIS, PC A18; 3; GPO Dep. Order Number DE88007186/JAW.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 under Contract No. DE-ACO1-85FE60600 with the United States Department of Energy. This study Appendix III, the second Wilhelm Sand and it's sub units and pools. Basic pressure, production and assorted technical data were provided by the U.S. Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can not additionally serve as a take off point for exploitation engineers to develop specific programs towards these ends. 15 figs., 9 tabs.

29928 **(DOE/FE/60600—T17-App.4) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General reservoir study, Appendix 4, Fourth Wilhelm Sand.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 01 Sep 1987. Contract AC01-85FE60600. 216p.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 with the United States Department of Energy. This study, Appendix IV, addresses the Fourth Wilhelm Sand and its sub units and pools. Basic pressure, production and assorted technical data were provided by the US Department of Energy staff at Elk Hills. Basic pressure production and assorted technical data were provided by the US Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can now additionally serve as a take off point for exploitation engineers to develop specific programs toward the end. 12 figs., 9 tabs.

29929 **(DOE/FE/60600—T17-App.6) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General Reservoir Study: Appendix 6, First Calitroleum Sand.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 1 Sep 1987. Contract AC01-85FE60600. 381p. NTIS, PC A17; 3; GPO Dep. Order Number DE88007189/JAW.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 under Contract No. DE-ACO1-85FE60600 with the United States Department of Energy. This study, Appendix VI, addresses the first Calitroleum Sand and its sub units and pools. Basic pressure, production and assorted technical data were provided by the U.S. Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent verification. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing future recovery have been suggested. It is hoped that this volume can now additionally serve as a take off point for exploitation engineers todevelop specific programs towards these ends. 12 figs., 9 tabs.

29930 **(DOE/FE/60600—T17-App.7) Western Shallow Oil Zone, Elk Hills Field, Kern County, California: General reservoir study: Appendix 7, Second Calitroleum Sand.** Carey, K.B. (Evans, Carey and Crozier, Bakersfield, CA (USA)). 1 Sep 1987. Contract AC01-85FE60600. 418p. NTIS, PC A18; 3; GPO Dep. Order Number DE88007190/JAW.

The general Reservoir Study of the Western Shallow Oil Zone was prepared by Evans, Carey and Crozier as Task Assignment 009 under Contract No. DE-AC0185FE60600 with the United States Department of Energy. This study, Appendix VII, the second Calitroleum Sand and its sub units and pools. Basic pressure, production and assorted technical data were provided by the U.S. Department of Energy staff at Elk Hills. These data were accepted as furnished with no attempt being made by Evans, Carey and Crozier for independent verfication. This study has identified the petrophysical properties and the past productive performance of the reservoir. Primary reserves have been determined and general means of enhancing futuree recovery have been suggested. It is hoped that this volume can now additionally serve as a take off point for exploitation engineers to develop specific programs towards these ends. 13 figs., 9 tabs.

29931 **(DOE/SF/01424—66) Big Muddy DOE Project: Final report.** Brister, W.L.; Borah, M.T.; Gregory, M.D. (Conoco, Inc., Casper, WY (USA)). Mar 1988. Contract AC03-78SF01424. 164p.

The Big Muddy Low-Tension Flood was a 90-acre demonstration project in the heart of the Second Wall Creek reservoir in the Big Muiddy Oil Field. The goal was to provide data for commercialization of the low-tension ehanced oil recovery process. Results wee therefore intended to help in the application of the process to other low-permeability and freshwater reservoirs in the Rocky Mountain region, particuarly the sandstone reservoirs similar to the Second Wall Creek at Big Muddy. There were 3 main phases of injection for the project. A brine preflush, followed by the low-tension slug and then a polymer drive. The polymer drive was later tapered back and eventually only produced project water was injected. The project was conducted with few operational problems. The injection plant operated as expected. On the production side, very little downtime occurred during the project. The oil treatment for sulfonate was troublesome at times, yet merchantable oil was always achieved. A total of 289,643 STBO were produced through May 31, 1987. Actual recovery was far short of expectations, only a fourth of original projections. Out of the total oil produced, 219,000 STBO are considered to be true tertiary oil. This was derived from a plot of the oil cut versus time, with the oil cut experssed as a percent of injection. All oil recovered above the waterflood baseline was tertiary oil. The chemical slug was optimized with respect to composition and viscosity to achieve maximum oil recovery and slug injectivity. The process design was good, but the project failed due to a lack of fluid containment. 14 refs., 68 figs., 28 tabs.

29932 **(NIPER—297) Oil recovery by immiscible CO_2 flooding: Topical report.** Chung, F.T.H. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1988. Contract FC22-83FE60149. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001220/JAW.

This report describes the results of studies made to investigate the mechanisms of immiscible CO_2 displacement and of coreflooding tests for East Eucutta oil (Mississippi). The measurements and correlations for the physical properties of heavy oil-CO_2 mixtures previously performed during this investigation have been reported. This report provides additional information about the properties of heavy oil-CO_2 mixtures and more detailed discussion about the mass transfer process and hydrocarbon extraction mechanisms. Research was focused on corflooding tests to assess oil recovery efficiencies and optimize injection strategy. The objective of this

project is to investigate the technical feasibility of the immuscible CO_2 flooding process in the East Eucutta oil field. Conventional flooding methods have been tested and results are presented in this report. 19 refs., 25 figs., 3 tabs.

29933 **(NIPER—305) Adsorption calorimetry and enhanced oil recovery: Three component systems, topical report.** Noll, L.A. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1988. Contract FC22-83FE60149. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001221/JAW.

One objective of this project is to determine the adsorptive losses of EOR chemicals on minerals in a systematic manner and expand adsorption models for incorporation as an adsorption module into chemical flooding simulators. The Woodbury-Noll adsorption model was developed which fits both amount and heat of adsorption simultaneously. Two ternary systems were selected with a view to extending the Woodbury-Noll adsorption model to these systems. In the first of these systems, DTAB/NaBr/H20/silica, competitive effects are not present. In the second system, methanol/toluene/heptane/silica, competitive adsoprtion is present. Flow adsorption calorimetry was carried out on these ternary systems and on their respective binaries. Adsorption calorimetry of DTAB from solutions with added electrolyte showed that the heat and the amount of adsorption increased when the salt content was raised to 3 percent, being approximately constant thereafter. However, the increase in salinity above this amount moved the plateau region to lower surfactant concentrations. Adsorption of DTAB at 45{degree}C resulted in lower adsorption than at 25{degree}C, but the heat release was only slightly lower. The heat and amount of adsorption of methanol from heptane onto silica are both markedly reduced by the presence of toluene in the solution. Densities of the surfactant solutions and of the binaries of methanol/toluene/heptane system are reported. 6 refs., 20 figs., 13 tabs.

0204 Processing

REFER ALSO TO CITATION(S) 29865, 30403, 30785, 30786, 30790

29934 **(NIPER—301) The thermodynamic properties of quinoline and isoquinoline: Topical report.** Steele, W.V.; Archer, D.G.; Chirico, R.D.; Collier, W.B.; Gammon, B.E.; Hossenloop, I.A.; Nguyen, A.; Smith, N.K. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Mar 1988. Contract FC22-83FE60149. 58p.

Measurements leading to the calculation of the ideal-gas thermodynamic properties for quinoline and isoquinoline are reported. Thermodynamic and thermophysical properties were determined by adiabatic heat-capacity calorimetry, comparative ebulliometry, densimetry, and combustion calorimetry. Vibrational spectra of quinoline and isoquinoline were assigned. Entropies and enthalpies for the ideal-gas state from the claorimetric measurements and from the vibrational assignments were derived and compared. Entropies, enthalpies, and Gibbs energies of formation were derived at selected temperatues between T→0 and 1000 K. new density measurements for benzene are reported. 55 refs., 11 figs., 16 tabs.

29935 **(PB—88-180484/XAB) Assessment of impacts on the refining and natural gas liquids industries of summer gasoline vapor-pressure control. Final report.** (Southwest Research Inst., San Antonio, TX (USA)). 24 Aug 1987. 161p. (SWR—8701). NTIS, PC A08/MF A01.

This report presents the results of a study of the economic impact of regulations that would reduce the vapor pressure of summer gasoline.

29936 **Poisoning of thiophene hydrodesulfurization by nitrogen compounds.** LaVopa, V.; Satterfield, C.N. (Massachusetts Institute of Technology, Cambridge (USA)). *Journal of Catalysis;* **110**: No. 2, 375-387(Apr 1988). Contract FG22-85PC80516.

The poisoning effect of nonsterically hindered nitrogen compounds, expressed as inhibition adsorption constants derived from Langmuir-Hinshelwood kinetics for thiophene hydrodesulfurization (HDS), correlated well with gas-phase basicity (proton affinity). The order of adsorption strength agrees generally with that reported for poisoning of hydroprocessing catalysts and of acidic cracking catalysts. Inhibitor adsorption constants from thiophene HDS studies correlated well with measurements of inhibition of the hydrodeoxygenation of dibenzofuran, even when the N-compound underwent considerable reaction and it was necessary to account for the inhibiting effects of reaction intermediates. Studies were on a $NiMo/Al_2O_3$ catalyst at 7.0 MPa and 300 to 400°C. 33 references.

29937 **Thiophene hydrodesulfurization over transition metal surfaces: structure insensitive over molybdenum and structure sensitive over rhenium.** Bussell, M.E.; Gellman, A.J.; Somorjai, G.A. (Univ. of California, Berkeley (USA)). *Journal of Catalysis;* **110**: No. 2, 423-426(Apr 1988). Contract AC03-76SF00098.

In this note the authors present results of thiophene hydrodesulfurization (HDS) experiments over molybdenum and rhenium single crystals. Previous work in their laboratory showed that a Mo(100) single crystal catalyzes thiophene HDS and that the product distribution is similar to the distribution obtained over an unsupported molybdenum disulfide (MoS_2) catalyst. The similarity of these results suggests that by determining the effects of surface structure and adsorbate overlayers (C, S) on thiophene HDS over molybdenum single crystals, one can gain insight about the nature of the active sites on MoS_2-based catalysts. This led the authors to expand studies to molybdenum single crystals of different surface orientations. They have also begun to investigate thiophene HDS over rhenium single crystals; rhenium disulfide (ReS_2) has been shown to be a more active HDS catalyst than MoS_2.

29938 **Metals contamination of aluminosilicate cracking catalysts by Ni- and VO-tetraphenylporphin.** Roth, S.A.; Iton, L.E.; Fleisch, T.H.; Meyers, B.L.; Marshall, C.L.; Delgass, W.N. (Argonne National Lab., IL (USA)). *Journal of Catalysis;* **108**: No. 1, 214-232(Nov 1987). Contract W-31-109-ENG-38.

The interaction of nickel and vanadyl tetraphenylporphin with amorphous silica-alumina, Y zeolite, and a cracking catalyst containing 15% Y zeolite has been studied with a variety of techniques. For the porphins on the silica-alumina and the cracking catalyst, electronic photoacoustic absorption spectrometry, electron paramagnetic resonance on V, X-ray photoelectron spectroscopy, and plasma desorption mass spectrometry confirm interaction of molecularly dispersed porphin molecules with the support but show no demetallation at temperatures below 120°C. Since the large porphin molecules cannot fit into the intracrystalline pore structure of the zeolite, the effective loading of those samples was several monolayers. Spectroscopic measurements showed, and scanning electron microscopy confirmed that the porphins form crystallites in this case. Blockage of a substantial portion of the external surface of the zeolite particles was indicated, however, by a large reduction in the measured intracrystalline pore volume after porphin impregnation. Infrared spectroscopy showed that porphin decomposition during calcination in air begins at 200-300°C. On the amorphous silica-alumina-containing materials, the decomposition extends over a 150°C range during programmed heating. Metal porphins on the zeolite support showed a sharp, apparently catalytic, exotherm and weight loss at a temperature more than 100°C higher than that for the onset of loss of molecular structure. These results show that interactions of metal porphins with cracking catalysts and their individual components are a strong function of coverage and that the decomposition of the porphins can be influenced by that interaction. 63 references.

29939 **Catalytic hydrodesulfurization over the Mo(100) single crystal surface. I. Kinetics and overall mechanism.** Gellman, A.J.; Neiman, D.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **107**: No. 1, 92-102(Sep 1987). Contract AC03-76SF00098.

The hydrodesulfurization of thiophene is catalyzed by the Mo(100) crystal surface at atmospheric pressures. The product distribution is similar to that detected over a high-surface-area powdered MoS_2 catalyst. Detailed kinetic studies have been performed in the 1 atm pressure regime and in the temperature range of 250-425°C. The initial reaction steps involve the desulfurization of thio-

phene to produce butadiene with an activation energy of 14.4 kcal-mol. Butenes and butane are produced via the subsequent hydrogenation of butadiene. The catalytic surface is predominantly covered with the partially hydrogenated hydrocarbon intermediates in the hydrogenation pathway. The hydrogen coverage on the other hand is very low and varies in proportion to $P^{1}2(H_2)$. 22 references.

29940 **Catalytic hydrodesulfurization over the Mo(100) single crystal surface. II. The role of adsorbed sulfur and mechanism of the desulfurization step.** Gellman, A.J.; Bussell, M.E.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **107**: No. 1, 103-113(Sep 1987). Contract AC03-76SF00098.

The study of thiophene hydrodesulfurization (HDS) over initially clean Mo(100) surfaces has been extended to include sulfided surfaces. Low sulfur coverages (0 ≦ theta/sub s/ < 0.67) inhibit HDS activity. Increasing the sulfur coverage in the range 0.67 ≦ theta/sub s/ ≦ 1.0 produces a surface with an HDS activity of about half that of the clean Mo(100) surface. Excessive exposure of the surface to a sulfur-containing environment results in the formation of a MoS_2 layer which is, at least in part, responsible for complete catalytic deactivation. Radiotracer (^{35}S) labeling techniques have been used to measure rates of hydrogenation of sulfur adsorbed on the Mo(100) surface. In ambient atmospheres of both hydrogen (1 atm) and the thiophene HDS reaction mixture ($P(H_2)$ = 1 atm, P(Th) = 2.5 Torr) the rate of hydrogenation of adsorbed sulfur is two orders of magnitude less than the HDS rate. This fact has been used to suggest that the desulfurization step of the reaction does not proceed via the formation of a tightly bound Mo-S species. 24 references.

29941 **Benzene hydrogenation over supported and unsupported palladium. I. Kinetic behavior.** Chou, P.; Vannice, M.A. (Pennsylvania State Univ., University Park (USA)). *Journal of Catalysis;* **107**: No. 1, 129-139(Sep 1987). Contract FG02-84ER13276.

The kinetics of benzene hydrogenation over supported Pd catalysts and unsupported Pd powder were examined under a wide range of reaction conditions. At temperatures below 433 K, apparent activation energies were routinely near 12.0 kcal/mol. The reaction order in hydrogen for supported catalysts increased from 0.5 to nearly 4 as the temperature increased from 353 to 573 K, and this same parameter for Pd powder showed a similar trend but was more temperature sensitive. The reaction order in benzene increased from zero to 0.8 over the same temperature range but a smaller difference was observed between the results obtained for supported and unsupported Pd. The activity of all the samples showed a temperature-dependent maximum near 495 K, but the unsupported Pd had a greater tendency to exhibit deactivation which was attributed to carbonaceous surface species formed from reversible dehydrogenation of adsorbed benzene. The lowest turnover frequencies occurred on the Pd powder whereas values 10-50 times higher were obtained over low-temperature reduced Pd catalysts prepared using Cl-containing precursors and acidic supports such as SiO_2-Al_2O_3 and TiO_2. The enhanced activity over these last two catalysts is attributed to additional benzene adsorption sites present on the support surface in the metal-support interfacial region. 51 references.

29942 **Benzene hydrogenation over supported and unsupported palladium. II. Reaction model.** Chou, P.; Vannice, M.A. (Pennsylvania State Univ., University Park (USA)). *Journal of Catalysis;* **107**: No. 1, 140-153(Sep 1987). Contract FG02-84ER13276.

A modified Langmuir-Hinshelwood (L-H) model has been proposed to describe benzene hydrogenation over both unsupported Pd and supported Pd catalysts. A general reaction sequence proposing sequential addition of H atoms to the benzene ring, with no a priori assumption of a rate-determining step, was used because computer analysis allowed the determination of selected rate and adsorption constants. To explain the observed kinetic behavior, it was necessary to include an auxiliary reaction - benzene dehydrogenation to various carbonaceous surface species - which inhibits the principal reaction. This model, which quantitatively includes hydrogen-deficient species that inhibit the hydrogenation reaction, satisfactorily explains all results that were obtained in this study and is also consistent with other reports in the literature related to isotopic exchange and deactivation reactions. To further evaluate this model, the values of the fitted parameters were analyzed with regard to their physical significance, and they were found to be consistent and within theoretical guidelines imposed by L-H kinetics. 51 references.

29943 **Radiotracer (^{14}C) and catalytic study of thiophene hydrodesulfurization on the clean and carbided Mo(100) single-crystal surface.** Bussell, M.E.; Somorjai, G.A. (Univ. of California, Berkeley (USA)). *Journal of Catalysis;* **106**: No. 1, 93-104(Jul 1987). Contract AC03-76SF00098.

The role of adsorbed carbon overlayers and possible product poisoning (H_2S and cis-2-butene) in the thiophene hydrodesulfurization (HDS) reaction over Mo(100) single-crystal surfaces was investigated. Using the β^- emitting ^{14}C isotope, it was shown that adsorbed carbon remains on the Mo(100) surface after many thiophene turnovers (TN ≈ 10^3). HDS activities measured for carbided surfaces were found to be identical to that of initially clean Mo(100) single crystals, suggesting that the active catalyst surface is carbon covered. Deactivation of the single-crystal catalysts was caused by adsorption of H_2S onto the active HDS sites. Removal of the H_2S by evacuation of the reaction mixture readily regenerated the catalyst's activity toward a fresh mixture of thiophene and hydrogen. The product cis-2-butene had no effect on the activity of the catalysts. 27 references.

0205 Products And By-products

REFER ALSO TO CITATION(S) 29954, 29993, 30521

29944 **(AD-A—189730/5/XAB) Cetane-scale evaluation and possible modification. Final report, 1 September 1984-31 August 1987.** Henein, N.A. (Wayne State Univ., Detroit, MI (USA). Center for Automotive Research). 23 Dec 1987. 118p. NTIS, PC A06/MF A01.

An evaluation is made of the validity and accuracy of the Cetane Scale in rating fuels used in diesel engines. Six problems were identified, analyzed, and possible solutions proposed. Three of the problems are intrinsic to the scale and are related to its inability to rate low-ignition-quality fuels, instability of the ignition delay meter and the inconformity of the CFR combustion system with actual diesel systems. The other three problems are related to fuels and engines. These are the invalidity of C.N. in correlating the ignition-delay data, its inaccuracy in ranking overall engine performance and emissions and its inability in rating the cold startability of engines on different fuels. The cold startability problem is investigated in two engines, under steady and actual starting conditions in a cold room. Also, a mathematical model is developed to predict the startability of the engine. These investigations indicate very clearly that the cetane rating is a hot-engine, high-temperature test and is unable to rate the cold startability of diesel engines.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 30402, 30403, 30435, 30439

29945 **(DOE/EIA—0109(88/01)) Petroleum supply monthly, January 1988.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Jan 1988. 117p.

Total US demand for petroleum products during January 1988 averaged about 17.2 million barrels per day, over 0.8 million barrels per day higher than the comparable figure of a year ago. This is the second consecutive month that demand has exceeded 17.0 million barrels per day. Product supplied data for the major products continued to follow seasonal demand patterns, with increases in distillates, residual fuel oil, and propane demand being offset by decreases in the demand for motor gasoline and asphalt and road oil. Other January 1988 highlights include that total product inventories fell over 8.8 million barrels in January to 709.1 million barrels; crude oil stocks (excluding SPR) continued to drop in January, falling from 349.3 million barrels to 345.5 million barrels

by month's end; and refinery utilization fell from December's rate of 83.4 percent to 82.8 percent. 11 figs.

29946 **(DOE/EIA—0173(87)) Annual report to Congress 1987.** (USDOE Energy Information Administration, Washington, DC). 29 Feb 1988. 66p.

In its first decade, the Energy Information Administration (EIA) has matured into an active member of the Federal statistical community and has continued to meet its obligations successfully as the Government's collector, processor, interpreter, analyst, and disseminator of energy information. EIA manages a broad publishing program that, in 1987, included 59 periodical titles and 21 analysis and Service Reports. EIA is divided into seven program areas-oil and gas information; coal, nuclear, electric and alternate fuels information; energy markets and end-use information; automated data processing services; information services, which includes the National Energy Information Center; statistical standards; and policy and management, which includes all administrative services. The sections that follow provide a synopsis of the 1987's activities for EIA in each energy field and service area, examples of significant data findings with pertinent graphs for 1987, and, in the appendices, lists of 1987 survey forms, models, and publications.

29947 **(DOE/EIA—0380(87/12)) Petroleum marketing monthly, December 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 3 Mar 1988. 164p.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase pride, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 12 figs., 53 tabs.

29948 **(LBL—21227) Substitution for petroleum products in Brasil: Urgent issues.** de Araujo, J.L.; Ghirardi, A. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 27p.

Brazililan energy policy during the last decade has focused on the replacement of imported petroleum with domestic energy sources, combined with efforts at conservation. The substitution results, however, have been more spectacular by far. The strategy of replacement is based on two elements. first, to increase domestic petroleum exploration and production. Second, to promote non-petroleum fuels as alternatives to the industrial and transportation sectors, for the substitution of fuel oil and gasoline, respectively. A combination of the substitution strategy, the country's petroleum refining structure, and the composition of the substitution strategy, the country's petroleum refining structure, and the composition of demand, has resulted in large surpluses of both gasoline and fuel oil, while diesel has become the most used among petroleum products. The surpluses are not easily exportable because there is ample availability of fuel oil in the world market, and because the low octane number of the gasoline produced in Brasil is not compatible with the engines of cars elsewhere in the region and in the world. Furthermore, although gasoline might be upgraded, the question remains that prospects for the world market are not encouraging, and an export-based strategy does not seem justified in view of the growing surpluses. The objective of this analysis is to review the mechanisms of themajor petroleum-substitution programs currently in existence, identifying their past impact on the energy market and the possible consequences of changes in the goals and operating conditions of these programs, in the light of the new prospects for increased domestic oil production and self-sufficiency. 23 refs., 2 figs., 1 tab.

0208 Waste Management

29949 **(UCRL—21044-Vol.2) Waste minimization study for the Lawrence Livermore National Laboratory: Solvent wastes: Final report.** (Bechtel National, Inc., San Francisco, CA (USA)). 31 Jul 1987. Contract W-7405-ENG-48. 372p.

Two solvent studies are described in Volumes 1 and 2 of the Final Report - one covering Site 300 and the second covering the General Plant program. At the Laboratory's request the writeup on a third solvent study was delayed, and in its place, is a Lead Waste Minimization Study, Volume 3 of the Final Report. Also, a Lead Integrated Management Program report was prepared and delivered to the Laboratory. Actually, four solvent studies were conducted. Site 300 and the General Plant program were among the largest users of solvents and/or the largest producers of solvent wastes according to a laboratory-wide survey. Primarily for that reason, they were chosen for the studies. Each of the studies in this report is a stand-alone document so that a person needing information for one program could quickly refer to that specific study and not have to unnecessarily read the other study. In general, solvent is used for degreasing, parts cleaning, equipment cleaning, and paint cleanup. Solvent wastes are generated from each of these operations. Volume 2 contains attachments for Volume 1.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 29922, 30414, 30417

29950 **(PB—88-172911/XAB) Ecosystem perspective on potential impacts of drilling-fluid discharges on seagrasses.** Kelly, J.R.; Duke, T.W.; Harwell, M.A.; Harwell, C.C. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). 1987. 28p. (EPA—600/J-87/237). NTIS, PC A03/MF A01.

Pub. in Environmental Management, Vol. 11, No. 4, 537-562(1987).

Potential effects of oil drilling-fluid discharges upon Thalassia seagrass ecosystems were examined to provide general insights and raise ecotoxicological issues relevant to problems of addressing a priori, ecolgical effects of anthropogenic actions. Microcosm experiments have demonstrated effects upon both autotrophic and heterotrophic species, as well as the processes of primary productivity and decomposition. Significant ecological changes may result from disturbance effects related to the physical presence of higher particle loads, in addition to effects resulting from toxic features of drilling fluids.

29951 **(PB—88-182845/XAB) Study of biological processes on the US mid-Atlantic slope and rise. Volume 1. Executive summary. Report for March 1984-March 1986.** Maciolek, N.; Grassle, J.F.; Hecker, B.; Boehm, P.D.; Brown, B. (Battelle Ocean Sciences, Duxbury, MA (USA)). 15 Dec 1987. 55p. NTIS, PC A04/MF A01.

See also PB—88-183090 and PB—87-214342.

Box core samples were collected at 14 stations as part of a monitoring program to evaluate potential effects of exploratory drilling in water depths of 1500 and 2100 m. The box core samples were analyzed for benthic infauna, hydrocarbons, sediment grain size, and total organic carbon, hydrogen, and nitrogen. Benthic infaunal diversity was high at all stations on all sampling dates. As a group, the shallower (1515-1613 m) stations were more diverse than the deeper stations. There was no evidence that hydrocarbons in the sediments, or hydrocarbons and metals in brittle stars and sea urchins, originated from sources associated with drilling activities.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 29935, 30400

0240 Storage

29952 **(SAND—87-3096C) Calculation of creep induced volume reduction of the Weeks Island SPR [Strategic Petroleum Reserve] facility using 3-D finite element methods.** Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880654—5).

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

Creep induced volume reduction of the Weeks Island Strategic Petroleum Reserve (SPR) Facility has been calculated using 3-D finite element models. Crude oil is stored in this room and pillar salt mine where the pillars can be sorted into three different categories based on depth and geometry. A 3-D finite element model was created to represent each of the three different pillar categories. The volume change of the three models was proportioned according to the number of pillars in each category to obtain the total volumetric response of the mine. The calculated volumetric response compares well with the measured volumetric response. 16 refs., 7 figs., 1 tab.

29953 **Big Hill site named one of 1987's top engineering achievements.** *Fossil Energy Review;* 12(Jan-Feb 1988).

The Strategic Petroleum Reserve's Big Hill site in Texas, the newest addition to the federal government's emergency crude oil storage complex, has been named one of the top US engineering achievements of 1987. Designed to hold 140 million barrels of crude oil, it will ultimately be comprised of 14 huge underground salt caverns, each 200 feet across and 2000 feet deep - a size taller than New York's World Trade Center. The oil storage caverns at the Big Hill site will be located more than 3000 feet below the surface in a massive salt dome. Last October, after three years of surface construction and the drilling of 28 wells (two for each cavern), workers activated a series of pumps sending the first of millions of barrels of fresh water deep into the salt dome to begin the leaching operation that creates the salt caverns. Approximately 70 million barrels of fresh water must be pumped into the salt to dissolve a single cavern. It takes approximately two-and-a-half years to develop a cavern to its full capacity, although oil can be stored while the leaching process is underway. Construction of the Big Hill facility has proceeded at less than half its original cost estimates. Initially the project was expected to cost $819 million, or the equivalent of $5.85 for each barrel of oil storage capacity. Today, with nearly 80% of the total project costs expended, the cost is estimated to be just under $400 million, or approximately $2.85 per barrel.

0250 Combustion

29954 **(PB—88-862230/XAB) Oil burners: crude oil, atomization, and combustion efficiency. January 1970-March 1988 (Citations from the NTIS data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 134p. NTIS PC N01/MF N01.

Supersedes PB—85-857068.

This bibliography contains citations concerning fuel properties and boiler-operations techniques to make maximum use of heavy crude oil, shale oil, and low-grade fuels to reduce energy costs in boiler firing. Fuel properties pertain to chemical constituents, viscosity, desulfurization, and processing methods to upgrade the fuels. Operating techniques include atomization, dual-fuel burners, emission characteristics, and cost factors. Combustion efficiency is examined and some citations report on additives or processing techniques to improve the efficiency. The citations also report on studies of health effects in the use of synfuels, mostly as coal liquids to replace oil. (This updated bibliography contains 248 citations, 72 of which are new entries to the previous edition.)

03 NATURAL GAS

29955 **(PB—88-182050/XAB) Measurement and analysis of two-phase flow through low-permeability media. Volume 1. Task 1. Theoretical research. Final report, November 1982-March 1986.** Arastoopour, H.; Hariri, H.; Newberg, M.; Semrau, J. (Institute of Gas Technology, Chicago, IL (USA)). May 1987. 507p. NTIS, PC A22/MF A01.

See also Volume 2, PB—88-182043, and Final rept. on Task 3, Nov 1982-Mar 1986, PB—86-233830.

A computer program based on mass and momentum equations for flow of gas through low-permeability porous media was developed. The calculated transient-gas-flow rates using the computer program agreed well with the experimental data generated under Task 2, for both dry and partially saturated tight-sand cores. Computer codes based on conservative and non-conservative mass and momentum equations for two-phase flow through low-permeability porous media were developed. IGT's modified BOAST Program was successfully applied to a nonfractured low-permeability gas reservoir under production.

29956 **(PB—88-183009/XAB) Data base for use in R and D appraisal and price-quantity forecasting at the Gas Research Institute. Annual report, September 1983-June 1984.** Marshalla, R.A.; Nesbitt, D.M.; Oman, D.B. (Decision Focus, Inc., Los Altos, CA (USA)). 1984. 325p. NTIS, PC A14/MF A01.

This fourth revision of the Gas Research Institute (GRI) technical data base contains cost, performance, resource, and economic data inputs to the GRI/DFI interfuel and intertechnology model used to compute supply-demand scenarios in support of the GRI Budget and project area planning. The report includes all existing and future technologies, fuels, and policy variables deemed important to GRI's long-range planning. It contains cost and performance estimates for the following technologies: coal-based synthetic fuels, electric generation, residential, commercial, industrial, transmission and distribution, and transportation. Also provided are the network structure, primary resource cost and availability estimates, assumptions on policy variables, and the 1982 energy supply-demand balance.

29957 **(PB—88-185343/XAB) Publications from basic sciences research: 1978-1986.** (Gas Research Inst., Chicago, IL (USA)). Nov 1987. 74p. NTIS, PC A04/MF A01.

This reference document is a compilation of basic sciences publications resulting from GRI-sponsored basic research projects from 1978 through 1986. The report contains references only to journals, proceedings, and book publications, not to GRI reports. The retrievable technical publications are referenced according to subject categories that correspond to GRI's Five-Year Research and Development Plan. The basic sciences effort emphasizes geosciences, the origin, migration, and recovery of natural gas; inorganic chemistry, coal chemistry, and biochemistry of processes that can generate supplemental gas supplies; combustion, heat and mass transfer, and electrochemistry phenomena; methane reactions and process technology; properties of high temperature materials; applications of biotechnology to natural gas utilization; properties of enhanced materials for gas-distribution operations; gas-flow fundamentals; physical and chemical properties of gases and gas mixtures; and the science underlying gas-separation technology and chemical processes.

0301 Reserves

29958 **(CONF-8706191—) Proceedings of the Alaskan gas utilization workshop.** (Alaska Univ., Fairbanks (USA); USDOE Assistant Secretary for Fossil Energy, Washington, DC). Sep 1987. Contract FG21-86FE61114. 118p.

From Alaskan gas utilization workshop; Fairbanks, AK, USA (30 Jun 1987).

The Alaskan Gas Utilization Workshop was a result of a 1985 Agreement between the State of Alaska and the US Department of Energy's Office of Fossil Energy. These two organizations and the University of Alaska's Petroleum Development Laboratory jointly sponsored the workshop to provide the opportunity for public input to identify the technical, regulatory, legislative, and research an d development actions required by private industry, the State and the Federal Government to make the utilization of Alaskan North Slope natural gas viable. Alaska has huge deposits of natural gas and about 3.3 billion cubic feet/day are being produced at Prudhoe Bay as associated gas in oil production operations. The workshop brought together representatives of the entire spectrum of organizations interested in, or impacted by, the utilization of Alaskan gas to discuss potential options. A workshop format employing small groups was adopted to encourage everyone to fully participate. A panel discussion by interested experts preceeded the workshop sessions to present many of the major issues. Then, over the next one and a half days, four parallel workshop groups covered all the gas utilization issues of interest, including new ideas and options. Individual papers have been processed for inclusion in the Energy Data Base. 24 refs., 1 fig., 13 tabs.

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 29918, 29919, 29920, 29921, 29977

29959 (DOE/MC/21181—1950-Vol.11) Geological evolution and analysis of confirmed or suspected gas hydrate localities: Volume 2, basin analysis, formation and stability of gas hydrates in the Black Sea. Ciesnik, M.S.;Krason, J. (Geoexplorers International, Inc., Denver, CO (USA)). May 1987. Contract AC21-84MC21181. 107p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE88001052/JAW.

This document is Volume 11 of a series of reports entitled "Geological Evolution and Analysis Confirmed or Suspected Gas Hydrate Localities." Volume 11 provides an analysis of the Black Sea region. The report presents a geological description of the Black Sea region, including regional and local structural settings, geomorphology, geological history, stratigraphy, and physical properties. Included also is a discussion of bottom simulating acoustic reflectors, sediment acoustic properties, distribution of hydrates within the sediments, and the relation of hydrate distribution to other features such as salt dispirism. The formation and stabilization of gas hydrates in sediments are discussed in terms of phase relations, nucleation, and crystallization constraints, gas solubility, pore fluid chemistry, inorganic diagenesis, and sediment organic content. A depositional analysis of the areas is discussed in order to better understand the thermal evolution of the locality and to assess the potential for thermogenic hydrocarbon generation. 80 refs., 27 figs., 16 tabs.

29960 (NMRDI—2-75-5339) Rock matrix and fracture analysis of flow in western tight gas sands: Phase 3: 1987 annual report. Morrow, N.R. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Mar 1988. 143p. NTIS, PC A; New Mexico Research And Development Institute, Pinon Building, Suite 358, 1220 South St. Francis Drive, Santa Fe, NM 87501; GPO Dep. Order Number DE88900488/JAW.

This report contains core analysis data for thirty-five MWX (Multi-Well) samples recovered from depths ranging from 4548 to 7278 feet. Pressure sensitivity of permeability to overburden pressure was found to correlate with depositional environment, with fluvial samples being the most pressure sensitive. Chemical treatments of core samples indicated the kinds of minerals at pore spaces, which are critical to determination of pressure sensitivity. Permeabilities along and across mineralized fractures are compared with those neighboring matrix rock. Acetic acid treatment of mineralized fractures resulted in over three-fold increase in permeability and marked reduction in pressure sensitivity. Tests on preserved and dried cores showed that reliable permeability measurements require the use of pereserved core. Improved presentation procedures for prevention of drying should be applied to low permeability gas sands.

29961 (PB—88-182043/XAB) Measurement and analysis of two-phase flow through low-permeability media. Volume 2. Task 2. Experimental research. Final report, November 1982-March 1986. Chowdiah, P. (Institute of Gas Technology, Chicago, IL (USA)). Mar 1987. 208p. NTIS, PC A10/MF A01.

See also Volume 1, PB—88-182050.

New experimental and data-analysis techniques were developed, leading to an improved understanding of laboratory data on tight-sand properties from the perspective of using such data as inputs during reservoir simulation. An apparatus was constructed for measuring gas-water capillary pressure curves and gas-phase relative permeabilities along a true drainage path on tight-sand samples at reservoir confining stress. A comparison of drainage gas-phase permeability data obtained using this apparatus with data from currently commercial measurement techniques that use evaporation to vary sample-water saturation show that the evaporation method yields data more representative of an inhibition process. Equations were derived for estimating pore structural parameters such as tortuosity, mean pore size, and formation resistivity factor from gas slippage data measured in the laboratory.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 29958

29962 (PB—88-196373/XAB) Analysis of eastern Devonian gas shales production data. Final report, July 1984-May 1987. Lancaster, D.E.; Lee, W.J.; Gatens, J.M. (Holditch (S.A.) and Associates, Inc., College Station, TX (USA)). May 1987. 370p. NTIS, PC A16/MF A01.

See also report dated July 1985, PB—86-125143.

This report summarizes the final results, conclusions, and recommendations from a study of well-test and production data from over 1600 Devonian Shale gas wells. The key accomplishment of the study was the development of a number of new analytical tools for well test and production data analysis including (1) an analytical production data analysis model, (2) an analytical well test analysis model, (3) an automatic history matching algorithm, (4) a set of production data anlysis type curves, and (5) the SUGARIII reservoir simulator. Although developed primarily for analyzing data from Devonian Shale gas wells, these tools are generally applicable to the analysis of well test and production data from a variety of reservoirs. From a systematic analysis of long-term production data, the permeability-thickness product was found to be the only reservoir property which can be accurately and uniquely determined from history-matching production data. Gas in place can also be determined provided that sufficient production data are available. Empirical equations were developed for predicting well performance from kh and GIP and from past production data when available.

29963 (PB—88-197413/XAB) Geologic, technical, and economic sensitivity analysis in support of the GRI (Gas Research Institute) tight-gas sands R and D program. Annual report, November 1986-October 1987. Haas, M.R. (Lewin and Associates, Inc., Washington, DC (USA)). Mar 1988. 107p. NTIS, PC A06/MF A01.

See also report dated Feb 87, PB—87-172839.

During 1986-87, Lewin and Associates, Inc., used the Tight Gas Analysis System (TGAS) and other analytic models to estimate the potential for tight gas and the effects of changes in economics, technology, and resource assessments. During the reporting period, TGAS was: (1) enhanced in its analytical capabilities in terms of costing and tax routines; (2) used to provide refined estimates of economic tight-gas potential from the Travis Peak formation; and (3) used to support GRI managers in R&D planning, evaluation, and technology transfer (e.g., PAM, Baseline, Hydrocarbon Models, and AGA and EMF submissions). A microcomputer version (PC-TGAS) was developed for dissemination to industry.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 29946, 29958, 29963, 29986, 29987, 30398, 30399, 30402, 30435

29964 (DOE/EIA—0130(88/01)) Natural gas monthly, January 1988. (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Jan 1988. 136p.

The Natural Gas Monthly (NGM) highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting the natural gas information. The data is this publication are collected on surveys conducted by the Energy Information Administrattion (EIA), of the Department of Energy (DOE to fulfill its responsibilities for gathering and reporting energy data. Some of the data are collected under the authority. 6 figs., 33 tabs.

29965 (GRI—87/0290) **Symposium on natural gas use in the production of Virgin Iron Units. Final report, November 1986-July 1987.** Leiter, C.P. (Gas Research Inst., Chicago, IL (USA)). Jul 1987. 222p. (CONF-8704262—; PB—88-129952). NTIS, PC A 10/MF A01.

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The Gas Research Institute (GRI) sponsored a one-day workshop on the role of natural gas in iron and steel making which brought major participants in the natural gas and steel making industries together to debate and assess critical trends in natural gas use. The consensus of the meeting was that 70 to 75 million tons of steel per year will be supplied by the domestic steel industry - 40 to 45 million tons by integrated producers from virgin iron units, and 30 to 35 million tons from scrap-based steel making. The potential shortage of coke in the 1990s can be partially alleviated by injection of natural gas into blast furnace tuyeres. The scrap supply can support a 20 million-ton-per-year increase in scrap-based steel making without depleting scrap reserves. With the use of currently available scrap and existing sorting practices, high-quality steel, including auto sheet and wire rod, can be made from scrap. As problems with control of residual elements on a heat-to-heat basis are solved with new melting and heat treating processes, more scrap and less pig iron will be used and DRI's expertise will be needed. All 14 papers have been abstracted separately for inclusion on the Energy Data Base.

29966 (GRI—87/0290, pp 6-14) **Overview of the US steel industry.** Deaner, M. (American Iron and Steel Institute, New York, NY (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

Last year world steel makers produced about 800 million tons of steel, a little less than was produced in 1985. Most of the industrialized countries and the centrally planned economy countries increased their production. Unfortunately, only a few companies made any money with all that production. This paper discusses the trade problems, the President's steel program to bring down import penetration, and how to achieve a restructuring of the domestic steel industry. The author lists several criteria that government assistance should meet to revitalize the American steel industry.

29967 (GRI—87/0290, pp 21-35) **Overview of the US steel industry scrap: supply, demand, and price structure.** Wulff, S.W. (David J. Joseph Co., Cincinnati, OH (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The continued rationalization and internationalization of the US steel industry will have direct impact on the ferrous scrap market. Some of the more obvious changes will include: continued shift away from integrated processes to the lower-capital-cost, more operationally flexible, smaller-scale electric furnace shops; reduced and redistributed production and availability of steel mill home scrap; import of semi-finished steel, allowing US mills to ship more product per ton of raw steel that is actually made here; and, likely, higher and more stable operating rates for the remaining steel producers. Steel mills and foundries in the US will have ample supplies of scrap for their furnaces. Scrap quality issues will demand increased attention from producers and suppliers. Though not a manufactured product, the quality of scrap delivered to consumers can and is being improved by suppliers who are attentive to what their customers are saying. Contamination by nonferrous metals or nonmetallic inclusions, density, size, and delivery are all criteria for assessing scrap quality that can be better controlled. Although realistic projections of raw steel production in the US are modest by historic standards, domestic demand for purchased scrap is likely to approach if not exceed past peaks. Scrap prices will respond to the rise and fall of steel production and demand for scrap; but scrap will remain a competitively-priced raw material for steel making. Sustained price levels higher than past records are not foreseen. A prolonged period of higher prices would certainly push consumers towards alternatives such as increased hot metal production or increased use of direct reduced iron. These changes would, however, lower demand for scrap, for which the price would again fall so that it once again becomes economically attractive to steel mills and foundries.

29968 (GRI—87/0290, pp 36-48) **Iron ore: supply, demand, and price structure.** West, A.S. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

After describing the activities and assets of Cleveland-Cliffs, the paper illustrates and discusses steel consumption, imports, and shipments; raw steel production; pellet production; and pellet pricing historically and now in the age of Chapter 11, overcapacity, and the development of the spot market. Natural gas's role in the production of iron ore pellets is also briefly summarized.

29969 (GRI—87/0290, pp 49-60) **Natural gas supply issues and price implications.** Ban, S.D. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The long-term prospects are good for natural gas to retain a strong role in the national energy mix well into the next century. Natural gas resources available in the US are large and in North America they are much larger. A range of other supplements exist for the very long-term. Only timely initiatives by the gas industry itself are required to maintain reliable supplies and stable, competitive prices. There are no certain bets in the energy supply outlook. But the future of natural gas supply rests with the industry and its customers acting in an increasingly competitive marketplace. It is not a tool of geopolitics as oil prices are, nor does it turn upon the direction of environmental policy decision as coal and nuclear do. The author believes the gas industry intends to remain a competitive, reliable supplier. GRI, on behalf of the industry, intends to carry out its responsibilities.

29970 (GRI—87/0290, pp 61-72) **Future of the US steel industry: trends in structure, finance, product mix, and import threats.** Marcus, P.F. (PaineWebber Inc., New York, NY (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

By the early 1990s, our most likely scenario calls for the domestic steel industry to have undergone a significant restructuring. Some of the noteworthy characteristics and conditions in the industry will include the following. US steel making capacity will be down about 20% from 1985. The mini-mills and reconstituted mills (those restructured due to bankruptcy or bankruptcy threats) will have a much larger market share. Most of the more efficient larger steel plants will fairly well maintain shipment levels through the early 1990s. Cost on 1987 dollars will be lower in the early 1990s as production is emphasized at the best facilities and cost reduction actions remain intense. Steel prices will also be lower than today. The iron ore industry will be smaller. Imports of steel slabs will rise sharply as more domestic producers meet their incremental production needs. Steel consumption will probably be 5% lower than in 1986. Continuous casting production will be up sharply, with about 82% of steel being continuously cast versus only 44% in 1985. The product mix will shift more towards more coated (galvanized steel) products. Energy consumption will also be much improved. The dollar will have strengthened versus the Japanese yen and Deutsche mark, and will continue strong versus Developing World currencies. New technologies will increasingly threaten the major products. Steel scrap will still be in abundant supply. Steel making capacity in the Western World will be lower than at the present time, with increases in the Developing World largely offset by declines in the Developed. The American steel industry will be cost competitive by international standards.

29971 (GRI—87/0290, pp 73-92) **Need for virgin iron units.** Geiger, G.H. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

To answer this question, the authors use a model of the relationship between steel making technology, steel consumption, and the demand for scrap. The model is driven by assuming a level of steel mill product shipments. This, after all, is what stimulates demand for both iron ore and scrap. Other independent economic variables that must be provided include the amount of net steel mill product imports and net scrap exports. Using the mathematical model, various scenarios can be tested to see what they do to scrap demand as the mix of process types (BOF vs EAF), percentage of continuous casting, and level of imports change. Within the rational range of changes, the demand for obsolete scrap varies from about 32MM tons per year to 37MM tons per year. At these levels, the net additions to scrap reserves continue to be in the 25 to 30 MM tons per year range. Therefore, the industry could increase scrap consumption by up to these levels and not stop the additions. The limiting factor is the collection ability of the scrap industry. The need for virgin iron units could decrease by 25MM tons per year before the industry would be in balance. This assumes, of course, that imports of steel stay at about the same level they have been at for the past twenty years, a not unreasonable assumption. The real need is for better scrap collection and processing facilities; that is, for scrap to be treated as a raw material and not as junk.

29972 (GRI—87/0290, pp 204-215) **Future of direct-reduced iron (DRI) in America.** Palm, S.K.; Agarwal, J.C.; Leiter, C.P. (Charles River Associates, Boston, MA (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The bulk of the world's current steel making capacity is based on production liquidation in a blast furnace followed by refining in a steel making furnace. After World War II, there was a great deal of interest in direct iron making processes in which iron ore is reduced to solid iron followed by electric furnace steel making. The literature is full of descriptions of many such processes. In the mid-1960s, steel makers began the installation of direct reduction plants. Currently, 23 million metric tons of DRI capacity have been installed in the Western world, yet most of this capacity exists in developing nations. The development of DRI in the US has lagged; only one commercial DRI plant, the Georgetown steel facility, is currently in operation. The purpose of this paper is to examine the role that DRI is likely to play in the future of the American steel industry. In order to perform this evaluation, the authors first review the status of iron supplies to the US steel industry, then examine the outlook for both imported and domestically produced DRI.

29973 **(PB—88-174248/XAB) Beating the competition in industrial energy markets: summary of the annual energy seminar for the Gas Research Institute Board of Directors and Advisory Council (8th), San Diego, California, August 10-12, 1987.** Farrell, M.D. (Gas Research Inst., Chicago, IL (USA)). Jan 1988. 44p. (GRI—87/0362). NTIS, PC A03/MF A01.

This document summarizes the major points made by speakers and participants in a GRI-sponsored energy seminar on the U.S. industrial sector. The first session presented GRI's analytical overview of the industrial sector and GRI's Industrial Utilization R&D Program Strategy that addresses the needs of the traditional heavy-gas-using industries. It also focused on the current position of gas in its traditional markets and the issues/technologies that will affect the future of gas in these markets from the perspective of a major industrial user (steel), a gas distributor, and an equipment manufacturer. The second session presented GRI's analytical perspective on the range of opportunities/challenges presented by new applications for gas technology in the industrial sector and the ongoing and planned R&D in GRI's efforts to find new markets for gas. Also presented were research efforts at Garrett AiResearch in the area of heat and cogeneration, and gas technology advances and future research needs in Great Britain.

29974 **(PB—88-178660/XAB) Gas Appliance Technology Center. Annual report, January 1985-December 1985.** Jayaraman, V. (American Gas Association Labs., Cleveland, OH). Aug 1987. 116p. NTIS, PC A06/MF A01.

See also Annual rept. for Jan-Dec 86, PB—88-163373.

This report reviews the activity during the third year of Gas Research Insitute's Gas Appliance Technology Center program. The report highlights the work done in assessing, evaluating, developing and demonstrating improved concepts in the areas of gas-fired residential/commercial appliances and residential/commercial space-conditioning systems. Specific development work pertaining to low-NOx ovens, commercial steamers and doughnut fryers is described. The extensive work done on corrosion of heat exchangers, removal of NO_2 from indoor air, emissions and venting, characterization of space heaters and development of advanced burner systems is covered. The results of several studies and laboratory evaluations of state-of-the-art appliances, including integrated appliances, performance test procedures, use of 2 psig gas in residential distribution systems, use of plumbing vents for venting flue products, schoolroom heaters and Btu meters are presented. Information is included on the Energy Research House, recently acquired in the Chicago area, and the characterization studies proposed on this and other houses.

29975 **(PB—88-184940/XAB) Status and evolution of the US aluminum industry: implications for natural gas. Topical report, February-October 1986.** Vejins, V.R.; Duroc-Danner, B.; Mullins, J.; Kusik, C.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1988. 105p. NTIS, PC A06/MF A01.

The objective of this report was to identify the factors that influence the market environment of the aluminum industry and broadly relate the structural and product changes to the need and appropriateness of new technologies, based on natural gas. Its purpose was to provide a quantitative perspective on the role of natural gas in U.S. industry; its competitive position vis-a-vis electricity; the technological changes that may potentially affect the use of gas; and projections for domestic energy use.

29976 **(PB—88-185319/XAB) Competitive position of natural gas: plastic forming and curing applications.** (Gas Research Inst., Chicago, IL (USA)). Dec 1987. 9p. NTIS, PC A02/MF A01.

See also PB—88-171798.

This summary is based on two Gas Research Institute (GRI) full reports, Competitive Position of Natural Gas: Central Thermal Fluid Systems (CTFS) for Plastics Curing and Forming, and Competitive Position of Natural Gas: Ovens for Curing and Heating Plastics Sheet and Film. The results of these studies indicate that gas-fired CTFSs are strongly competitive with other methods of platen heating, especially at moderate to large sizes. The total potential market is about 5 to 6 billion cubic feet per year (Bcf/yr) for CTFS and from 5 to 10 Bcf/yr for gas-fired laminate or sheet-product curing ovens. Because temperature control is less accurate and responsive for gas-fired infrared curing ovens, electric ovens dominate the market. However, the lower capital and operating cost of the gas equipment may provide sufficient margin for incorporation of improved temperature controls that would enable gas to satisfy process requirements at the lowest cost.

29977 **(PB—88-185327/XAB) Gas-supply perspectives.** Woods, T.J. (Gas Research Inst., Washington, DC (USA). Strategic Analysis and Energy Forecasting Div.). 1987. 10p. NTIS, PC A02/MF A01.

The severity of the decline in drilling activity and prices since 1985 raises some questions on whether projections of the long-term gas supply and demand outlook in the 1987 Gas Research Institute (GRI) Baseline Projection are achievable. This paper addresses these questions by examining the size of the resource base and the likelihood of its being produced under reduced price expectations, and the extent to which near-term gas supply can remain adequate given sharply reduced drilling activities. Analysis indicates that, with relatively stable discovery rates and the improved recovery of gas-in-place, prospects are reasonable for holding gas production near current levels through the end of the century without rapidly growing rates of drilling activity. As the expectation of high oil and gas prices recede further into the future, new technology will assume an increasingly important role in maintaining adequate gas supply.

29978 **(PB—88-185350/XAB) Policy implications of the 1987 GRI (Gas Research Institute) baseline projection of US energy supply and demand to 2010.** (Gas Research Inst., Chicago, IL (USA)). 1987. 17p. NTIS, PC A03/MF A01.

Color illustrations reproduced in black and white.

This summary is based on the Gas Research Institute (GRI) insights titled 1987 GRI Baseline Projection of the U.S. Supply and Demand to 2010. The paper highlights three major issues. First, the 1987 projection reflects a permanent change in the energy intensity of the economy: there will be intensified competition due to increased efficiency of energy use, and gas will have to capture a greater share of total energy demand to reach projected demand levels of 19 to 20 quads. Second, as excess production capability is absorbed and wellhead gas prices return to replacement-cost levels, flexible transportation pricing will be necessary to compete in the price-sensitive, fuel-switching markets. Third, patterns of natural gas transportation could change significantly by 2010, with changing regional sources of supply accompanied by a shift in gas-demand patterns.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 29960

29979 **(PB—88-182027/XAB) GRI's (Gas Research Institute's) unconventional natural gas subprogram. Status report.** (Gas Research Inst., Chicago, IL (USA)). Dec 1983. 143p. (GRI—83/0085). NTIS, PC A07/MF A01.

This document discusses the status of 1983 ongoing and planned activities in GRI's Unconventional Natural Gas Subprogram. The program is part of a broad research program technologies for providing new gas supplies from natural and synthetic sources while also addressing economic, environmental, and safety issues. Project areas supporting the subprogram are tight gas sands, eastern Devonian gas shales, co-production of gas and water, and methane form coal deposits. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a 1983 status review sheet for projects within the project area.

29980 **(PB—88-182035/XAB) Natural-gas-supply subprogram status report, 1987.** (Gas Research Inst., Chicago, IL (USA)). Dec 1987. 137p. (GRI—87/0357). NTIS, PC A07/MF A01.

See also report for 1986, PB—88-107982.

This document discusses the status of 1987 ongoing and 1988 planned activities in GRI's Natural Gas Supply research and development program to ensure the cost-effective recovery of gas from marginal resources. Areas covered are tight gas sands, eastern devonian gas shales, secondary gas recovery technologies, advanced technologies for exploration and production, and methane from coal deposits. Presented are objectives and goals, accomplishments, strategy and basis for each project area, and a status review sheet for projects within the project area.

29981 **Multiwell experiment shows potential for gas from tight sands.** *Fossil Energy Review;* 6-7(Jan-Feb 1988).

A six-year, $30 million federal experiment now being concluded in Colorado has very likely accelerated the day when natural gas can be produced economically from massive lens-shaped, underground rock formations scattered throughout the western US. Already results from the test program indicate that it may be possible to produce gas from these elliptical deposits at costs of $2.50 to $3.00 per thousand cubic feet. Lenticular tight sands are deeply-buried deposits of sandstone, each one shaped much like the wing of an airplane. Their discontinuous nature and concrete-like porosity - they can be up to 30 times less permeable than conventional natural gas deposits - have made gas product both risky and costly. A major part of the Multiwell Experiment was to create new fractures or open up and link existing fractures. Beginning in 1983, researchers conducted the first frac jobs by injecting a gel-like substance under high pressure into the wells. The gel failed to perform properly, and initial production was poor. Researchers turned to a water-nitrogen foam for subsequent fracture tests with significantly better results. A proppant made up of tiny ceramic beads was injected into the fractures to hold them open. The strong, lightweight ceramic beads were found to be more effective than the more conventional sand particles used commercially. Researchers have now developed a model to simulate hydraulic fracturing at other sites. It predicts the geometry of hydraulic fractures as well as the way the proppant is transported and settles in the reservoir.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 29958, 30400

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 29958

29982 **(PB—88-192422/XAB) Reference standard polyethylene resins and piping materials. Final report, October 1, 1986-September 30, 1987.** Grissman, J.M.; Guttman, C.M.; Maurey, J.R.; Fanconi, B.M.; VanderHart, D.L. (National Bureau of Standards, Washington, DC (USA)). Mar 1988. 71p. (NBSIR—88/3705). NTIS, PC A04/MF A01.

Also available from Supt. of Docs. See also report dated March 1987, PB—87-173035.

Polyethylene piping is currently in widespread use in gas distribution in the United States, and represents approximately 80% of new installation. Research currently being performed on gas pipes often employs many different polyethylenes selected from the large number of polyethylenes available for this use. This variation in materials makes it difficult to compare results from different research laboratories. To avoid this difficulty, the Gas Research Institute and the National Bureau of Standards (NBS) have undertaken to provide a permanent store of one particular polyethylene resin as well as piping and fittings made from it which would provide a source of well-characterized materials for research related to gas-distribution systems. This report describes characterizations performed on the two types of T-joints and the starting resin from which they were manufactured. In preliminary work it was found that the melt flow rate of material taken from the two types of joints differed from that of the starting resin and differed from each other by as much as a factor of two.

0330 Properties

REFER ALSO TO CITATION(S) 29959

29983 **(PB—88-172325/XAB) Analyses of natural gases, 1917-1987. Data file.** Hamak, J.; Miller, R.; Cupell, L. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1987. mag tap. NTIS CP T02.

Supersedes PB—87-157855; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

This tape contains routine analyses and related source data for 14704 natural-gas samples. These samples were collected as a part of a continuous survey of the free world for occurrences of helium. The survey was conducted in the United States by the Bureau of Mines since 1917. In late 1965, the study was expanded to include foreign gas fields. Samples released for publication were published in a series of USBM bulletins and information circulars. The tape contains samples received through December 31, 1987 that were released for publication. (It replaces previous tapes forwarded to users.) There is one record on the tape for each sample analysis. The tape does not contain a label, standard or non-standard. The tape is a nine-track, 1600-BPI, odd-parity, ASCII tape. Each record contains 365 characters. The records are blocked 1 (one) per block. Helium Field Operations of the Bureau of Mines, located in Amarillo, Texas, may be contacted for further information.

0340 Combustion

REFER ALSO TO CITATION(S) 29876, 30526, 30599

29984 (GRI—87/0290, pp 93-100) **Use of gas in the blast furnace complex.** Scuilli, C. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

This paper discusses the use of natural gas in the blast furnace process and deals with its specific use in the blast furnace as a means of reducing coke. Anticipating the rather large range of participants at the session here, the author describes the blast furnace process in a little more detail than might be appropriate for some who are obviously very familiar with it. Natural gas offers distinct advantages over the other injectants due to its high replacement ratio, its ease of injection, and its low capital cost. The author is anticipating a potential consumption of about 2.5 million Btu's per ton of hot metal for natural gas in the blast furnace process.

29985 (GRI—87/0290, pp 135-164) **Sidor's experience in the production and use of direct reduced iron in the Venezuelan steel industry.** Dam, O.G. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

Since the early days of the development of the Direct Reduction processes, Venezuela has been one of the countries most suitable for such a technological development. This is due to the availability of natural resources, natural gas, high purity iron ore reserves and hydroelectric power from the Guri Dam electrical complex in Bolivar State. Venezuela is the world largest DRI producer based on Natural Gas Reduction. The presentation of Sidor's experience in the production of DRI using Natural Gas as the energy source and its application for steel making is the aim of this paper. Detailed descriptions of the processes existing at Sidor are not provided as this information will be presented by representatives of these processes in the panel. Nevertheless, the future trends of these processes are discussed.

29986 (GRI—87/0290, pp 165-169) **Gas-based direct reduction in the United States.** Lepinski, J.A. (Midrex Corp., Charlotte, NC (USA)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

Production of DRI in the US peaked in 1979 when 790,000 tons of DRI were produced. Since that time, US direct reduction capacity has been scaled back significantly due to a combination of high natural gas prices and low scrap prices. Today the MIDREX Plant at Georgetown Steel Corporation (GSC) is the only direct reduction plant operating in the US. This paper discusses trends favoring the use of direct reduced iron, current economics, and future prospects.

29987 (GRI—87/0290, pp 170-182) **Use of natural gas in the FIOR process.** Smailer, R.M.; Triplett, D.W. Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The FIOR direct reduction process is a proven technology, in current operation, and with total export product sales exceeding 2,000,000 metric tons. FIOR is a registered trademark of this process and is an acronym derived from the first letters of Fluidized Iron Ore Reduction. This is a continuously operating, fluidized bed process which utilizes iron ore fines, natural gas, electricity and raw water to produce pillow shaped DRI briquettes which exhibit a high level of metallization, uniform chemical composition, superior safety characteristics during transportation and storage, and superior physical strength. The first and only commercial FIOR plant currently consumes natural gas at the rate of approximately 7.35 trillion Btu's per year while producing 350,000 metric tons per year of briquetted product. The operation of this plant has proven to be a successful, cost effective means of adding significant value to local raw materials - iron ore fines and natural gas. This paper serves two primary objectives. The first is to describe the process as designed and operated in the existing plant with emphasis on current natural gas consumption. The second objective is to examine potential enhancements to a second generation FIOR plant design in terms of improved efficiencies of natural gas consumption.

29988 (GRI—87/0290, pp 183-203) **HYL III: the optimal use of natural gas for DRI production.** Dominguez, C.; Becerra, J. (HYLSA, Monterrey (Mexico)). Jul 1987. NTIS, PC A 10/MF A01. (CONF-8704262—; PB—88-129952).

From Symposium on natural gas use in the production of virgin iron units; Chicago, IL, USA (23 Apr 1987).

The production of virgin iron units is needed in the iron and steel industry in order to supply steel makers with pure iron necessary to dilute the contaminating elements of scrap. This production of virgin iron units is done both through the Blast Furnace (BF) and Direct Reduction Processes (DR). The BF is the most common large scale production system, while DR has proven to be economical at both large and small scales from about 300 thousands tons per year to about 2 to 3 million tons per year of Direct Reduced Iron (DRI) by operating several modules. Production of DRI requires a source of reductants for the chemical reduction of the ore and a source of thermal energy to provide the necessary heat of reaction and the sensible heat to reach the adequate temperatures. Among all the Direct Reduction technologies currently in use or offered for licensing, the HYL III process offers the lowest consumption of natural gas as the source of reductants of about 1.3 Gcal/ton of DRI, and the most flexible scheme of fuel substitution for process heating. HYL III also can produce Hot Briquetted Iron (HBI) of high density for easier and lower transportation cost of iron units by train, truck, barge or ship with considerable advantages when the end user of DRI is located over great distances from the production site. This paper describes the thermodynamics of direct reduction, the HYL III process, use of alternative fuels (coal gas), and the HYL III process with hot briquetting of DRI.

29989 (PB—88-191002/XAB) **GRI's (Gas Research Institute's) Gas Appliance Technology Center: 1987 report (activities at Battelle). Annual report, January-December 1987.** Locklin, D.W. (Battelle Columbus Div., OH (USA)). Feb 1988. 47p. NTIS, PC A03/MF A01.

This report reviews the activity at Battelle during 1987. Specific GATC activities in 1987 included: analyses and experiments on gas power burners, to be summarized in a Technology Bulletin; design and construction of a multi-function garage heater as a conceptual appliance; upgrading the VENT-II computer program for design of gas appliance vents; and exposure tests of candidate nonmetallic materials for condensing heat exchangers. Activities directed to technology transfer included: preparation and distribution of the quarterly G/A/S Newsletter; extension of the GATC InfoBase as a computerized bibliographic data base pertaining to the GATC scope; co-sponsorship of an International symposium on condensing heat exchangers; and managing a GATC/Industry Workshop.

29990 (PB—88-191010/XAB) **Bibliography on design for corrosion resistance in gas appliances - with emphasis on condensing heat exchangers: through 1987. Topical report.** Hindin, B.; Murphy, M.J.; Liljenberg, G. (Battelle Columbus Div., OH (USA)). Jan 1988. 41p. NTIS, PC A03/MF A01.

See also PB—82-240003.

The references listed in this document were selected and indexed for the convenience of equipment manufacturers and others interested in the design of corrosion-resistant residential and commercial gas appliances. The bibliography was compiled and indexed from the Gas Appliance Technology Center (GATC) InfoBase, an electronic data base in the area of gas-appliance technology. The bibliography contains citations of technical reports, journal articles, books, patents, and other documents related to gas appliances. The GATC InfoBase is an evaluated, rather than a comprehensive, data base, which means that all references in it and in this related bibliography were selected by researchers working in the field of corrosion and gas appliances. Many older, classic references are included.

0350 Storage

REFER ALSO TO CITATION(S) 30645

29991 **(PB—88-190996/XAB) Development of improved technologies and techniques for reducing base-gas requirements in underground natural gas storage facilities. Annual report, April 1986-August 1987.** Damle, A.S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jan 1988. 153p. NTIS, PC A08/MF A01.

See also report dated December 1987, PB—88-150073.

This project investigates the feasibility of the inert-gas injection concept for reduction in base-gas requirements. A three-dimensional, two-phase-flow numerical code was developed to simulate a natural gas storage field to determine mixing of the natural gas with an inert gas. The code is applicable for a dry-gas storage field as well as an aquifer storage field. The inert-gas-mixing simulations indicated excellent retention of inert gas in the field. The rate and duration of the injection/Withdrawal cycle (i.e., the amount of gas withdrawn in a single cycle) was found to be the most dominating factor in determining the concentration profiles and the rate of loss of inert gas. The experimental studies, conducted at North Carolina State University facilities, indicated the overall gas-phase dispersion coefficient to be of the same order as molecular diffusion. The numerical predictions were compared successfully against controlled experimental data on mixing between two gases in a porous medium.

04 OIL SHALES AND TAR SANDS

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 29934, 30828, 30829

0405 Properties And Composition

29992 **(UCRL—21022) MSRS [Multispecies Shale Retorting Simulator]: A Fortran code for the numerical dynamic simulation of solid/fluid reactions in nonisothermal multispecies porous spheres with Stefan-Maxwell diffusion: Final report.** Johnson, S.H.; Hindmarsh, A.C. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Mechanical Engineering and Mechanics; Lawrence Livermore National Lab., CA (USA)). Feb 1988. 78p.

This manual describes the Fortran code MSRS (Multispecies Shale Retorting Simulator), the model equations that it solves, and the subroutines that the user must write to define a particular simulation. When used with Petzold's differential/algebraic equation solver, DASSL, numerical dynamic simulations can be produced which model multiple, reversible or irreversible reactions with Arrhenius reaction rate temperature dependence, among multiple porous solid reactants and multiple fluid reactants. Only spherically symmetric pellets of unchanging outer radius are treated but the pellets can be nonisothermal and of nonconstant porosity. Flick's First Law and Fourier's Law govern fluid mass and energy (solid temperature) transport. A stagnant thin film model for boundary transport is included. It is hoped that user feedback will develop to guide the future evolution of the code. (8 refs.)

0406 Direct Uses And By-products

29993 **(AD-A—189278/5/XAB) Aviation turbine fuels from tar-sands bitumen and heavy oils. Part 3. Laboratory sample production. Interim technical report, 1 July 1983-30 September 1986.** Moore, H.F.; Johnson, C.A.; Benslay, R.M.; Sutton, W.A. (Ashland Petroleum Co., KY (USA)). Dec 1987. 89p. NTIS, PC A05/MF A01.

See also Part 1, AD-A151 319.

The purpose of this research and development project is to provide sample quantities of aviation turbine fuel derived from tar sands and heavy oil feedstocks for testing and evaluation in programs sponsored by the Air Force Wright Aeronautical Laboratories (AFWAL). Samples of specification JP-4 Mil-T-5624L, JP-8 Mil-T-83133A, and variable quality JP-4 samples were produced via pilot plant operations. Data generated from Phases I, II, and III, were used to 1) optimize the processing scheme, 2) generate process material and energy balances for a commercial-sized plant, and 3) provide a detailed final flow diagram of the processing scheme. A final economic analysis was performed based on all contract data available.

05 NUCLEAR FUELS

REFER ALSO TO CITATION(S) 30304

0504 Feed Processing

29994 **(INIS-BR—1065) Determination of rare earth elements, hafnium and cadmium in sintered pellets of mixed thorium and uranium oxides by neutron activation.** Cardoso, S.N.M. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1987. 105p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702763/JAW.

This work shows the development of a method for determination of the rare-earth elements (Eu, Sm, Dy and Gd), Hf and Cd contents in sinterized U and Th mixed oxides by neutron activation analysis. The sample is dissolved in nitricfluoridric (0,1% HF) medium, to dryness and redissolved in 6N HCl solution. The Hf is extracted into organic phase (0,5 M TTAbenzene), irradiated and analysed through ^{181}Hf isotope energy peak. The aqueous phase is treated with NH_4OH for the precipitation of hidroxides. Then, these are dissolved in 6N HNO_3 solution. The extraction of U and Th is made in two steps, one with $TBPCCl_4$ and another with 0,5 M $TTAC_6H_6$. Then the rare-earth elements and Cd are irradiated and determined by gamma spectrometry.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 30310, 30546, 30737, 31139

29995 **(FMPC—2114) Environment, Safety, Health and Waste Management Plan.** (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 11 Mar 1988. Contract AC05-86OR21600. 237p.

The mission of the Feed Materials Production Center (FMPC) is the production of high qaulity uranium metal for use by the US Department of Energy (DOE) in Defense Programs. In order to accomplish this mission and to maintain the FMPC as a viable facility in the DOE production complex, the facility must be brought into full compliance with all federal and state regulations and industry standards for environmental protection and worker safety. Where past practices have resulted in environmental insult, a comprehensive program of remediation must be implemented. The purpose of this combined Environment, Safety, Health and Waste Management Plan is to provide a road map for achieving needed improvements. The plan is structured to provide a comprehensive projection from the current fiscal year (FY) through FY 1994 of the programs, projects and funding required to achieve compliance. To do this, the plan is subdivided into chapters which discuss the applicable regulations;project schedules and funding requirements;details of the various programs for environment, safety, health and waste management;details of the ongoing National Environmental Policy Act (NEPA);the quality assurance program and the environmental monitoring program. 14 refs., 30 figs., 29 tabs.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 30105, 30807

29996 **(CONF-860820—15) Partitioning of iodine in offgas generated by dissolution of spent nuclear fuel.** Birdwell, J.F.; Weber, F.E. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemical Engineering). Aug 1986. Contract AC05-84OR21400. 14p.

From 19. DOE/NRC nuclear air cleaning conference; Seattle, WA, USA (17 Aug 1986).

A cvomputer simulation of a dissolver offgas scrubbing system has been developed in order to study iodine retention in the liquid phase throughtout the system. In addition, the effects of steam stripping and air sparging on iodine accumulation have been investigated. The model includes determinations of vaporliquid iodine partitioning and NO/sub x/ removal in an absorption column. The results of the simulations indicate that iodine is retained in the liquid phase at levels on the order of 10/sup {minus/5} gmolliter. Sparging and steam stripping both reduce the liquid-phase concentration of iodine in the system. The greatest reduction in liquid-phase iodine retnetion observed in the simulations was approximately 35{percent}. Unfortunately, the use of an air sparge to volatilize iodine (which it does quite effectively) causes a decrease in NO/sub x/ scrubbing efficiency by lowering the concentration of NO/sub x/ in the scrubbing column vapor. However, NO/sub x/ removal efficienceis were determined to exceed 90{percent} in all flowsheets simulated. 10 refs., 2 figs., 6 tabs.

29997 **(FMPC—2109) Equipment for the handling of thorium materials.** Heisler, S.W. Jr.; Mihalovich, G.S. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1988. Contract AC05-86OR21600. 12p. (CONF-880201—14).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The Feed Materials Production Center (FMPC) is the United States Department of Energy's storage facility for thorium. FMPC thorium handling and overpacking projects ensure the continued safe handling and storge of the thorium inventory until final dispositio n of the materials is determined and implemented. The handling and overpacking of the thorium materials requires the design of a system that utilizes remote handling and overpacking equipment not currently utilized at the FMPC in the handling of uranium materials. The use of remote equipment significantly reduces radiation exposure to pesonnel during the handling and overpacking efforts. The designed system combines existing technologies from the nuclear industry, the materials processing and handling industry and the mining industry. The designed system consists of modified fork lift truck for the transport of thorium containers, automated equipment for material identification and inventory control, and remote handling and overpacking equipemnt for repackaging of the thorium materials. The radiation exposure to operations personnel using the remote handling and overpacking equipment is expected to be reduced by 98% over conventional direct durm handling practices with no dose reduction controls. 1 ref., 5 figs., 1 tab.

29998 **(INIS-GB—129) BNFL Sellafield: post audit progress, December 1987.** (Health and Safety Executive, London (UK). Nuclear Installations Inspectorate). Dec 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753093/JAW.

The report of the safety audit at the Sellafield site was published in December 1986. In this, the Health and Safety Executive required British Nuclear Fuels (BNFL) to make improvements to the site and safety cases have had to be produced. These have now to be assessed by the Nuclear Installations Inspectorate. BNFL has undertaken programmes of maintenance, refurbishment and replacement of equipment. Much of this work was done in the shut-down maintenance period in the spring and summer. However, more work is needed to bring plants up a condition suitable for operating for the next ten years. BNFL have also started to decontaminate and decommission disused, contaminated, plants. This will generate a large amount of radioactive waste. BNFL have to build plants to containerise and encapsulate the waste prior to disposal. Waste disposal sites to complete the clean-up process are needed. The improvements to the engineering plants, to written procedures and to training, are reported. Changed attitudes are also noted. (U.K.).

29999 **(INIS-GB—135) Sellafield site (including Drigg) emergency scheme manual.** (British Nuclear Fuels Ltd., Sellafield). Feb 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753609/JAW.

This Emergency Scheme defines the organisation and procedures available should there be an accident at the Sellafield Site which results in, or may result in, the release of radioactive material, or the generation of a high radiation field, which might present a hazard to employees and/or the general public. This manual covers the general principles of the total emergency scheme and those detailed procedures which are not specific to any single department. (U.K.).

30000 **(WHC-SA—0090-FP) Irreversible dissolution of solid solutions: A kinetic and stoichiometric model.** Murphy, W.M.; Smith, R.W. (Westinghouse Hanford Co., Richland, WA (USA)). Sep 1987. Contract AC06-87RL10930. 19p. (CONF-870965—6).

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

A model for the kinetics and stoichiometry of irreversible dissolution of solid solutions is developed mathematically for an ideal binary system. The principal assumptions in the model are that the forward (dissolution) reaction is stoichiometric and zero order, that the reverse (growth) reaction stoichiometry corresponds to the solid that is most stable with respect to the aqueous solution (greatest affinity to precipitate), and that the surface composition is homogeneous but variable in time. The model is applied to analogs of spent nuclear fuel with the compositions U/sub 0.99/Pu/sub 0.01/O_2 and U(IV)/sub 0.99/U(VI)/sub 0.01/O/sub 2.01/. Numerical computations of mass release in a closed system indicate that in the first example, the aqueous solution comes to equilibrium with a PuO_2 enriched surface. In the second example, the solution achieves equilibrium with a surface that is depleted in U(VI). 24 refs., 2 figs.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 29997, 30290, 30824, 30839

30001 **(PB—88-862578/XAB) Hazardous materials transportation: radioactive materials and wastes. May 1985-April 1988 (Citations from the NTIS data base). Report for May 1985-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 155p. NTIS PC N01/MF N01.

Supersedes PB—87-856761.

This bibliography contains citations concerning the transportation portion of the nuclear fuel cycle. Topics include routing procedures, programs undertaken by national laboratories, appropriate state legislation, and cost assessments. Considerable attention is given to container design, development, and testing. (This updated bibliography contains 320 citations, 108 of which are new entries to the previous edition.)

30002 **(PNL—6430) Reactor-specific spent fuel discharge projections, 1987-2020.** Walling, R.C.; Heeb, C.M.; Purcell, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 102p.

The creation of five reactor-specific spent fuel data bases that contain information on the projected amounts of spent fuel to be discharged from U.S. commercial nuclear reactors through the year 2020 is described. The data bases contain detailed spent fuel information from existing, planned, and projected pressurized water reactors (PWR) and boiling water eactors (BWR), and one existing high temperature gas reactor (HTGR). The projections are based on individual reactor information supplied by the U.S. reactor owners. The basic information is adjusted to conform to Energy Information Administration (EIA) forecasts for nuclear installed ca-

pacity, generation, and spent fuel discharged. The EIA cases considered are: No New Orders (assumes increasing burnup), No New Orders with No Increased Burnup, Upper Reference (assumes increasing burnup), Upper Reference with No Increased Burnup, and Lower Reference (assumes increasing burnup). Detailed, by-reactor tables are provided for annual discharged amounts of spent fuel, for storage requirements assuming maximum at-reactor storage, and for storage requirements assuming maximum at-reactor storage plus intra-utility transshipment of spent fuel. 8 refs., 8 figs., 10 tabs.

30003 **(SAND—88-0055C) Technical issues relevant to the transport of commercially generated high-level nuclear waste in the United States.** Sanders, T.L.; Allen, G.C. Jr.; Ottinger, C.A.; Sandoval, R.P.; Dwight, C.C. (Sandia National Labs., Albuquerque, NM (USA); USDOE Idaho Operations Office, Idaho Falls). 1988. Contract AC04-76DP00789. 7p. (CONF-880601—9; TTC—0773; CONF-880601—).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Given the large number and diversity of casks expected to be used for nuclear waste transportation operations beginning in the late 90's, the DOE intends to address some high priority cask technical issues in a timely and assertive manner before the submission of safety analysis reports for individual packages. Open exchanges between DOE and Nuclear Regulatory Commission (NRC) have been initiated on a limited number of issue topics which are currently being investigated in depth to develop sufficient technical justification to pursue resolution of the issues. These issues are: (1) burnup credit, (2) source term containment evaluation, (3) transportable storage casks, and (4) cask weeping. 7 refs.

30004 **(SAND—88-0567C) StateGEN/StateNET: A methodology to assess local-area routing alternatives.** Cashwell, J.W.; Erickson, C.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 7p. (CONF-880354—4; TTC—0786).

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

The StateGEN/StateNET system is designed to allow the user to construct a transportation network on a PC, to assign attributes to the network, and to determine routes based upon a user-specified set of weighted route attributes using the TRANSNET system of transportation risk and ssytems analysis models.

30005 **(SAND—88-0568C) TRANSNET: Online transportation risk analysis for public use.** Cashwell, J.W.; Erickson, C.M.; Kern, E.A. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). Feb 1988. Contract AC04-76DP00789. 8p. (CONF-880201—32; TTC—0785).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The TRANSNET system of transportation risk and systems analysis models and associated data bases was developed to allow access by qualified users to information and technique developed under the sponsorship of the Department of Energy (DOE) Office of Defense Programs. The TRANSNET system allows outside users to access the RADTRAN III transportation risk analysis model as well as associated logistics, cost and netowrk models, and data. TRANSNET contains the most recent versions of models developed under DOE sponsorship. Code modifications that have been made since the last published documentation are noted to the user on the TRANSNET screens. To permit a greater spectrum of users to have access to the models, considerable attention has been given to makign them user-friendly and to provide default data sets for typical problems. 5 refs.

0510 Marketing, Economics, And By-products

REFER ALSO TO CITATION(S) 30021

0520 Waste Management

REFER ALSO TO CITATION(S) 29995, 30145, 30290, 30410, 30498, 30534, 30812, 30815, 31069, 31090, 31095, 31096, 31097, 31137, 31140, 31141, 31933

30006 **(AD-A—189020/1/XAB) Recommendations to the NRC (Nuclear Regulatory Commission) for review criteria for alternative methods of low-level radioactive waste disposal. Task 2a. Below-ground vaults. Final report.** Denson, R.H.; Bean, D.L.; Ainsworth, D.L.; Bennett, R.D.; Wamsley, R.M. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Jan 1988. 75p. (WES/MP/SL—88-2). NTIS, PC A04/MF A01.

Also available as Rept. no. NUREG/CR-5041-VOL-1.

Huntsville has developed general design criteria and specific design review criteria for the below-ground vault (BGV) alternative method of low-level radioactive waste (LLW) disposal. A BGV is a reinforced concrete vault (floor, walls, and roof) placed underground below the frost line, and above the water table, surrounded by filter blanket and drainage zones and covered with a low-permeability earth layer and top soil with vegetation. Eight major review criteria categories have been developed, ranging from the loads imposed on the BGV structure through material quality and durability considerations. Specific design review criteria have been developed in detail for seven of the eight major categories.

30007 **(AD-A—189708/1/XAB) Properties of laboratory-tested specimens of concrete from small-scale seal performance tests at the Waste Isolation Pilot Plant. Final report, July 1985-February 1987.** Comes, G.D.; Wakeley, L.D.; O'Neil, E.F. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Structures Lab.). Sep 1987. 86p. (WES/TR/SL—87-9). NTIS, PC A05/MF A01.

Development and field placement of a salt-saturated concrete at the Waste Isolation Pilot Plant (WIPP) included extensive testing of field-cast specimens in laboratory. Such test specimens were cast during two field events, each part of the Small-Scale Seal Performance Tests (SSSPT) at the WIPP, designated Test Series A and B. This report presents data from laboratory tests of SSSPT specimens at ages of three days to one year. The concrete maintained desired physical properties throughout the testing program, maintaining a volume increase, and achieving a compressive strength of near 7,000 psi at one year. Data were analyzed by a curve-fitting computer program, and are presented in figures showing best-fitting curves, which are models of the concrete properties with time.

30008 **(AEEW-M—2469) Immobilisation in cement of ion exchange resins arising from the purification of reagents, used for the decontamination of reactor circuits. Second semestrial report January-July 1987.** Howard, C.G.; Lee, D.J. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752726/JAW.

Decontamination of reactors normally results in large volumes of liquid effluent. At present the most effective method of reducing the volume of waste is to remove the activity by passing the solution through an ion exchange column. The aim of the programme at present is to show that ion exchange resins used to remove activity from decontaminating agents can be successfully immobilised in cement. To achieve this, blends of Ordinary Portland Cement (OPC) and ground granulated Blast Furnace Slag (BFS) will be used initially. Initial results presented in a previous report showed that BFS blended with OPC in the ratio 9:1 produced a satisfactory product containing 40% ion exchange resin. Further work has now been undertaken to improve the product's properties and the waste loading. The use of microsilica, a finely divided form of silicon dioxide, has also been investigated as an additive to cement. This has resulted in a further improvement in the product's properties. The mechanical and rheological properties of

waste forms incorporating microsilica have been investigated. The final part of the report deals with the immobilisation of ion exchange resin which has been treated with simulant decontaminating solution, together with an assessment of the effect of picolinic acid and formic acid on cement hydration. A new technique for measuring the expansion of grouts in the first 48 hours curing has been evaluated.

30009 **(AEEW-R—1992) Quality checking task force destructive testing of active waste forms.** James, J.M.; Smith, D.L. (UKAEA Atomic Energy Establishment, Winfrith). Mar 1987. 50p. (ILWRP—85/P28). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752731/JAW.

The implications of sampling and testing of full size active packages of intermediate level wastes are summarised in this report. Sampling operations are technically feasible but a major difficulty will be the disposal of secondary waste. A literature survey indicated that destructive testing of wasteforms is not carried out as a routine operation in Europe or the USA.

30010 **(AEEW-R—2196) Immobilisation of shredded waste in a cement monolith.** James, J.M.; Smith, D.L. (UKAEA Atomic Energy Establishment, Winfrith). Nov 1987. 42p. (PCMRP—84-P20). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752741/JAW.

During 1983/1984 work was continued on the development of the process for the encapsulation of shredded waste in cement. Using simulant shredded waste the conditions for operating the process on the 500 litres scale have been established. Evaluation of the cemented product showed that it was satisfactorily infilled with cement grout with no significant voidage.

30011 **(AERE-R—12292) Further observations of the swelling of bitumens and simulated bitumen wasteforms during γ-irradiation.** Johnson, D.I.; Hitchon, J.W.; Phillips, D.C. (UKAEA Harwell Lab. Materials Development Div.; Department of the Environment, London (UK)). Jun 1986. 35p. (DOE-RW—86.139). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753087/JAW.

This report concludes the work done to date on the swelling of bitumen-based materials during γ-irradiation. The experiments described include: (i) the behaviour of two CEC reference wasteforms RWF7 and RWF9, (ii) the results of long term measurements on two large samples, in 30 litre and 200 litre drums, of a simulated bitumen wasteform comprising 48 sup(w)o of magnesium hydroxide in Mexphalte 25 bitumen: and (iii) the results of experiments designed to test the predictions of a computer model for bitumen swelling. A previous report described two models for irradiation swelling of bitumen-based materials, the IL^2 model and the more complex, bubble growth, computer model. The experimental results reported show that the simple IL^2 model does not hold for either the reference wasteform RWF9 or the large samples of the simulated bitumen wasteform. Possible reasons for the failure of this model are put forward.

30012 **(AERE-R—12495) Transport in the undersaturated zone. October 1985 - September 1986.** Jackson, C.P.; Williams, M.G. (UKAEA Harwell Lab. Theoretical Physics Div.; Department of the Environment, London (UK)). Feb 1988. 10p. (DOE-RW—87.078). H.M. Stationery Office, London, price Pound 4.00.

Undersaturated conditions are likely to occur in the vicinity of shallow land repositories for radioactive waste. To provide for safety assessments of such repositories, we have formulated two simple mathematical models of radionuclide transport within undersaturated media: the first takes account of advection, dispersion, radioactive decay and sorption; the second model also of diffusion from mobile into immobile water. These models have been incorporated within a code formed by combining the Harwell finite-element codes, NAMMU and NAMSOL. The enhanced code has been verified by comparing numerical results with analytical solutions of simple benchmark problems.

30013 **(AERE-R—12558) Effect of EDTA and citrate on alpha decontamination processes.** Beaven, G.W.; Bodsworth, K.; Cross, J.E.; Hooper, E.W.; Wilkins, M. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Jul 1987. 49p. (LETTF—86-P34; PCMRP—86-P17; DOE-RW—87.058). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752744/JAW.

The results of a study investigating the effect of the complexants EDTA and citrate on the actinide decontamination achieved by precipitation and ultrafiltration treatment processes are presented. A computer simulation study employing the computer code PHREEQE has been used to predict the chemical speciation and solubility of plutonium, americium and neptunium in a waste effluent during its treatment by either a ferric or uranic floc process. Three different concentrations of the complexants were considered. The model's predictions have subsequently been validated by a small number of experimental measurements. It is concluded that the presence of both EDTA and citrate affect the actinide decontamination achieved by precipitation and ultrafiltration processes. The actinides readily form complexes with EDTA and citrate which increase their solubilities in aqueous systems and these complexes appear to be less readily adsorbed onto the flocs than the hydrolysis products that would be present in the absence of the complexants. The extent to which EDTA and citrate complexation takes place depends on the concentration of the complexant present; however, the results indicate that actinide decontamination is still adversely affected at the lowest complexant concentrations (10^{-6}M) considered.

30014 **(AERE-R—12624) Calciner performance in the vitrification of HLW and MLW. Collation of rotary kiln experimental data.** Taylor, R.F.; Wall, G.P.; Ambrose, D.C. (UKAEA Harwell Lab. Chemical Engineering Div.). Feb 1988. 25p. (DOE-RW—87.119). H.M. Stationery Office, London, price Pound 6.00.

This paper collates the results of some hundred runs on the calculation of high-level waste simulates using a 92mm diameter rotary kiln, and more recently a 200mm diameter unit. Kiln-wall temperature gradients have been measured, and residence times and calcination kinetics analysed. Denitration in the calcination zone has been modelled. Kiln performance and reliability of the final product have been studied.

30015 **(AERE-R—12871) Joule ceramic melter. Annual report for the period 1 July 1985 - 30 June 1986.** Morris, J.B.; Hollinrake, A.; Wall, G.P.; Dalton, J.T.; Paige, E.L.; Sutcliffe, P.W.; Finch, J.E.; Watson, B. (UKAEA Harwell Lab. Chemical Engineering Div.; Department of the Environment, London (UK)). Dec 1987. 38p. (DOE-RW—87.106). NTIS (US Sales Only), PC A03/MF A01 - H.M. Stationery Office, London, price Pound 6.00. Order Number DE88753506/JAW.

Work has restarted on installing the full-scale Joule Ceramic Melter which is to be used to evaluate the JCM process for vitrifying fast reactor high level wastes. The small Experimental Test Melter has been commissioned. Its electrodes corrode significantly if a sediment of conducting RuO_2 particles is allowed to accumulate. Supporting laboratory-scale experiments have been performed to assist in the elucidation of the corrosion mechanism. The objective of seeking more durable glasses by utilising higher temperature formulations has been deferred since initial experiments with simulated PFR waste failed to secure a significant improvement.

30016 **(ANL—88-5) Speciation of radionuclides in natural groundwaters: Annual report for the period October 1986 through September 1987.** Doxtader, M.M.; Beitz, J.V.; Reed, D.T.; Bates, J.K. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 62p.

Two ultrasensitive laser techniques, laser photoacoustic spectroscopy (LPAS) and laser-induced fluorescence (LIF), are being developed for the detection and speciation of trace levels of actinides in solutions typical of those expected in a high-level waste repository. An LPAS system was set up for these studies. Experiments were carried out to determine the detection limits of plutonium and americium in solution. Concurrently with the LPAS work,

LIF studies were carried out on uranyl ion and curium in solution. 32 refs., 35 figs., 8 tabs.

30017 **(BMI/ONWI—660) Coupled Fluid, Energy, and Solute Transport (CFEST) model: Formulation and user's manual.** Gupta, S.K.; Cole, C.R.; Kincaid, C.T.; Monti, A.M. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Oct 1987. Contract AC02-87CH10290;AC02-83CH10140. 467p. NTIS, PC A; 20; GPO Dep. Order Number DE88007750/JAW.

The CFEST (Coupled Fluid, Energy, and Solute Transport) code has been developed to analyze coupled hydrologic, thermal, and solute transport processes. It treats single-pahse Darcy groundwater flow in a horizontal or vertical plane, or in fully three-dimensional space under nonisothermal conditions. The code has the capability to model discontinuous and continuous layering, time-dependent and constant sources/sinks, and transient as well as steadystae ground-water flow. The code offers a wide choice of boundary conditions such as precsribed heads, nodal injection or withdrawal, constant or spatially varying infiltration rates, and welemental source/sink. Initial conditions for the flow analysis can be prescribed pressure or hydraulic head. The heterogeneity in aquifer permeability and porosity can be described by geologic unit or explicity for given elements. Three-dimensional elelments are generated from user-defined well logs at each surface node. To facilitate interaction between disciplines, support programs are provided to plot the finite element grid, well logs, contour maps of input and output parameters, and vertical cross sections. Ground-water travel paths and times and volumetric rates from a specified point can be determined from support programs. This report includes governing partial differential equations, finite element formulation, a use's manual, verification test examples, sample problems, and source listings. 36 refs., 121 figs., 36 tabs.

30018 **(BNL-NUREG—40867) Biodegradation of ion-exchange media.** Bowerman, B.S.; Clinton, J.H.; Cowdery, S.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880201—30).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The purpose of this study was to investigate further the potential for ion-exchange media (resin beads or powdered filter media) to support biological growth. A mixed microbial culture was grown from resin wastes obtained from the BNL HFBR by mixing the resin with a nutrient salt solution containing peptone and yeast extract. Bacterial and fungal growths appeared in the solution and on the resins after 7 to 10 days incubation at 337{degree}C. The mixed microbial cultures were used to inoculate several resin types, both irradiated and unirradiated. 12 refs., 5 tabs.

30019 **(BNL-NUREG—40940) A mechanistic model for leaching from low-level radioactive waste packages.** Kempf, C.R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 17p. (CONF-880201—31).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The development of a waste leaching model to predict radionuclide releases from porous wastes in corrodible outer containers in unsaturated conditions and/or conditions of intermittent water flow is summarized in this paper. Three major processes have been conceptualized as necessarily participating in waste leaching: infiltration of water to the waste package; interaction of this water with the waste; and exit of radionuclide-laden water from the waste package. Through the exit point, the main features of the whole leaching process are held in common. The departure occurs in two main ways: 1) the method of entrance of the radionuclides to leachant (i.e., part of the waste-water interaction phase outlined earlier); and 2) the mode of exit from the waste form/waste package (i.e., the exit of radionuclide-laden water phase). The first branching point, which occurs in relation to 1), leads to either readily soluble species directly entering leachant on contact, or to other processes {emdash} mainly expected to be diffusion, dissolution or ion exchange, or some combination thereof. All of these latter processes will be slow compared to the first branch (ready solubilization). The modeling work presented here concentrates on early releases due to the accessing and solubilization readily available radionuclides (i.e., the waste-water interaction phase has been discussed for accessible, soluble species). The exit mode phase, 2) above, has been divided into a rinsing mechanism and a diffusion mechanism. Results of each of the modeled exit mechanisms are presented and discussed. 20 refs., 9 figs., 2 tabs.

30020 **(CONF-860905—33) Source-term development for commercial low-level radioactive waste.** Godbee, H.W.; Kibbey, A.H.; Forsberg, C.W.; Storch, S.N.; Clower, T.J. (Oak Ridge National Lab., TN (USA)). [1986]. Contract AC05-84OR21400. 17p.

From International meeting on low, intermediate and high level waste management - decontamination and decommissioning; Niagara Falls, NY, USA (14 Sep 1986).

Generic source terms base don historical data have been developed for commerical low-level radioactive waste (LLRW) from fuel-cycle and non-fuel-cycle facilities. These source terms are used in DOE's Integrated Data Base (IDB) Program to estimate historical and projected volumes, radioactivity, and thermal power (from radioactive decay) of LLRW to the year 2020. Periodically, the source terms are updated as new waste is generated and as information on older waste is reviewed, redefined, and upgraded by the generator. Other segments of the nuclear industry also use source terms in planning for waste treatment, transportation, and storage systems. Several uses of source terms are illustrated. For example, the reported volume and radioactivity of LLRW added annually to commerical burial sites are compared with the calculated annual values obtained by summing contributions based on source terms for each generator. Likewise, accumulative radioactivity and thermal power of buried LLRW obtained by using an average source term and a synthesis of individual source terms are compared. 6 refs., 8 figs, 5 tabs.

30021 **(CONF-860970—3) Design of pumpable cement-based grouts for the immobilization of hazardous materials.** Gilliam, T.M.; McDaniel, E.W.; Dole, L.R. (Oak Ridge National Lab., TN (USA)). [1986]. Contract AC05-84OR21400. 5p.

From 3. world congress on chemical engineering; Tokyo, Japan (21 Sep 1986).

Cement-based grouts have proven to be an economical and environmentally acceptable means of waste disposal. Costs can be reduced if the grout is pumped to the dispoal site. This paper presents a systematic approach to guide the development of pumpable grouts. 7 refs., 1 fig.

30022 **(CONF-871075—Vol.1-Pt.2) 1987 Oak Ridge model conference: Proceedings: Volume I, Part 2, Waste Management.** (Analysas Corp., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 398p.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A conference sponsored by the United States Department of Energy (DOE) was held on Waste Mangement. Topics discussed were waste stabilization technologies regulations and standards, innovative treatment technology, waste stabilization projects. Individual projects are processed separately for the data bases. (CBS)

30023 **(CONF-871075—Vol.1-Pt.3) 1987 Oak Ridge model conference: Proceedings: Volume I, Part 3, Waste Management.** (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 423p.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

A conference sponsored by the United States Department of Energy (DOE), was held on waste management. Topics of discussion were transuranic waste management, chemical and physical treatment technologies, waste minimization, land disposal technology and characterization and analysis. Individual projects are processed separately for the data bases. (CBS)

30024 **(CONF-871075—Vol.2) 1987 Oak Ridge model conference: Proceedings: Volume 2, Environmental protection.** (Analysas Corp., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 387p.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

See the abstract for Volume I for general information on the conference. Topics discussed in Volume II include data management techiques for environmental protection efforts, the use of models in environmental auditing, in emergency plans, chemical accident emergency response, risk assessment, monitoring of waste sites, air and water monitoring of waste sites, and in training programs. (TEM)

30025 **(CONF-871075—Vol.3) 1987 Oak Ridge model conference: Proceedings: Volume 3, Health and safety.** (Analysas Corp., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 377p.

From 3. Oak Ridge model conference on waste problems; Oak Ridge, TN, USA (13 Oct 1987).

See the abstract for Volume I for general information on the conference. Topics discussed in Volume III include the use of models in handling hazardous materials, communication at waste sites, asbestos, regulatory decisions, emergency planning, training programs, occupational hazards, and protection of subcontractors. (TEM)

30026 **(CONF-880484—1) Analytical methods for large-scale sensitivity analysis using GRESS [GRadient Enhanced Software System] and ADGEN [Automated Adjoint Generator].** Pin, F.G. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 9p.

From Workshop on high level waste disposal; Stockholm, Sweden (11 Apr 1988).

Sensitivity analysis is an established methodology used by researchers in almost every field to gain essential insight in design and modeling studies and in performance assessments of complex systems. Conventional sensitivity analysis methodologies, however, have not enjoyed the widespread use they deserve considering the wealth of information they can provide, partly because of their prohibitive cost or the large initial analytical investment they require. Automated systems have recently been developed at ORNL to eliminate these drawbacks. Compilers such as GRESS and ADGEN now allow automatic and cost effective calculation of sensitivities in FORTRAN computer codes. In this paper, these and other related tools are described and their impact and applicability in the general areas of modeling, performance assessment and decision making for radioactive waste isolation problems are discussed. 7 refs., 2 figs.

30027 **(CONF-880510—1) Innovative technologies for the treatment of hazardous and mixed wastes.** Eyman, L.D.;Anderson, T.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 13p.

From International symposium on the management of low and intermediate level radioactive wastes; Stockholm, Sweden (16 May 1988).

The treatment, storage, and disposal of hazardous and mixed wastes incur significant costs for Department of Energy (DOE) installations. These wastes must be managed under strict environmental controls and regulations to prevent the possibility of migration of hazardous materials to the biosphere. Through the Hazardous Waste Remedial Actions Program, the DOE is seeking to develop innovative ways of improving current treatment technologies to eliminate the hazardous components of wastes, reduce waste management costs, and minimize the volume requiring disposal as hazardous or mixed waste. Sponsored projects progress from research and development to field demonstration. Among the innovative technologies under development are supercritical water oxidation of hazardous chemicals, microwave-assisted destruction of chlorinated hydrocarbons, paramagnetic separation of metals from waste, detoxification and reclamation of waste acid, nitrate destruction through calcination, treatment/disposal of reactive metals, and methodologies for encapsulation. Technologies at a demonstration phase include detoxification of mixed waste sludge, microbial degradation of polychlorinated biphenyls in soil, and the remediation process for a hydrocarbon spill. 14 refs.

30028 **(CONF-880604—5) Treatment of ORNL liquid low-level waste.** Berry, J.B.; Brown, C.H. Jr.; Fowler, V.L.; Robinson, S.M. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p.

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

Discontinuation of the hydrofracture disposal method at Oak Ridge National Laboratory (ORNL) has caused intensive efforts to reduce liquid waste generation. Improving the treatment of slightly radioactive liquid waste, called process waste, has reduced the volume of the resulting contaminated liquid radioactive waste effluent by 66%. Proposed processing improvements could eliminate the contaminated liquid effluent and reduce solid low-level waste by an additional one-third. The improved process meets stringent discharge limits for radionuclides. Discharge limits for radionuclides are expected to be enforced at the outfall of the treatment plant to a creek; currently, limits are enforced at the reservation boundary. Plant discharge is monitored according to the National Pollutant Discharge Elimination System (NPDES) permit for ORNL. 1 ref., 4 figs., 2 tabs.

30029 **(CONF-8708226—1) Risk-benefit perception: The research challenge.** Peelle, E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006974/JAW.

From Conference on perception of risk; Seattle, WA, USA (6 Aug 1987).

Factors predisposing to perception of repositories as risky include the nuclear track record of secrecy and ineptitude, the overconfidence of some pro-nukes and the premature commercialization of an immature technology. Then, in parallel, we have the AEC-DOE track record including a bureaucratic approach involving premature policy decisions and continual changes in nuclear waste policy as demanded by Congress. The confusion of nuclear power with nuclear weapons is encouraged by those whose goal is to get rid of nuclear power. Media coverge feeds on controversy and a crisis, is a major factor in public perception of N-power and repositories as risky. Beyond their actual physical effects, there is the signal value of accidents such as Browns Ferry, Chernobyl, the Hanford tank leaks, Challenger, and TMI. These accidents have signaled that either the managers and operators don't understand the technology well enough to manage it, or worse yet, that the technology itself may not be manageable. With wodefully inadequate science and technology eduation, US citizens are unprepared to make decisions about management and uses of technology or to conduct their own risk evaluations. All of the above is occurring against the backdrop of the widespread and pervasive decline of trust in government and institutions in the past 25 years. And finally, there is Murphy's Law - everyone has some personal knowledge that whatever can go wrong will go wrong some day. In this social context, the tilt is toward perception of repositories as risky.

30030 **(DOE/AL/10752—38) A critical assessment of continuous air monitoring systems at the Waste Isolation Pilot Plant.** Rodgers, J.C.; Kenney, J.W. (New Mexico Health and Environment Dept., Santa Fe (USA). Environmental Evaluation Group). Mar 1988. Contract AC04-78AL10752. 67p. (EEG—38).

An extensive review of the expected performance of the Waste Isolation Pilot Plant (WIPP) Continuous Air Monitor (CAM) instrumentation for monitoring of airborne transuranic (TRU) radionuclides has been completed. The CAM design chosen and installed at WIPP represents a significant departure from the original bid specifications for this system, and appears to have failed to meet the minimum performance requirements for such devices. A particularly significant finding of the asessment is that this instrument is likely to fail to properly correct for the background interference caused by the collection of radon and thoron progeny collected on the filter during long-term continous sampling. Although the analysis was limited by the unavailability of actual performance data, detailed computer simulations were used to identify specific aspects of the expected instrument response which contribute to its anticipated shortcomings. Among the specific problems identified in addition to background subtraction were potential loss of sample in nozzles and transport lines, and sample loss or distor-

tion in the CAM head itself due to impaction or asymmetrical deposition during sampling. 16 refs., 12 figs., 4 tabs.

30031 **(DOE/ER—0344) Site-directed subsurface environmental initiative: Five year summary and plan for fundamental research in subsoils and in groundwater, FY 1989-FY 1993.** (USDOE Office of Energy Research, Washington, DC. Office of Health and Environmental Research). Oct 1987. 45p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006895/JAW.

The overall goal of this research initiative is to develop the necessary scientific basis for resolution of key technical obstacles to defining and remediating contamination at DOE and other waste sites. To accomplish this goal, the resouces of the national laboratories, universities, and DOE sites will be fully utilized to develop and demonstrate improved, cost-effective, and environmentally acceptable techniques for predicting the behavior of contaminants and reducing their concentrations in ground water. This document is a preliminary plan to set general research directions for a program extending into the 1990s. The needs and milestones identified in this plan may change with additional guidance from DOE sites. Promising research opportunities will be identified as part of national laboratory submissions of preliminary proposals.

30032 **(DOE/ID—12631) Central Interstate Low-Level Radioactive Waste Compact Commission: Regional management plan, Final report.** (Dames and Moore, New York (USA)). Aug 1987. Contract AC07-76ID01570. 175p.

Licensable (or traditional) shallow land burial results in the greatest computed exposure of the alternatives evaluated. The other alternatives in descending order of impact are belowground vaults, enhanced shallow land burial, augered holes, modular concrete containers, and earth mounded concrete bunker monoliths. The maximum exposure is received approximately 10,000 years after the closure of the facility and results primarily from the long-lived isotopes I-129 and C-14. This maximum dose is approximately four orders of magnitude below that received from natural background radiation and two orders of magnitude below the level proposed by NRC as the lower limit for consideration in developing population dose commitments. It is not anticipated that any public exposure would result in the groundwater from migration of nuclides emplaced in a mine. Similarly, the groundwater may not be the critical exposure pathway for at-or abovegrade technologies. 39 refs., 3 figs., 3 tabs.

30033 **(DOE/ID—22073) Hydrogeology and geochemistry of the unsaturated zone, Radioactive Waste Management Complex, Idaho National Engineering Laboratory, Idaho.** Rightmire, C.T.; Lewis, B.D. (Geological Survey, Idaho Falls, ID (USA)). Nov 1987. Contract AC07-76ID01570. 97p. (MISC—20487).

To assess the potential migration of low-level radioactive waste in the shallow subsurface, a study on the geochemistry of the unsaturated zone at the Radioactive Waste Management complex (RWMC), Idaho National Engineering Laboratory, on the eastern Snake River Plain in southeastern Idaho was done. Stable isotope and chemical data suggest that the perched water obseved beneath the RWMC is not due to vertical infiltration through the ground surface, but is due to lateral flow of water that infiltrated through the diversion ponds. The water accumulates as a perched mount on the thick, laterally continuous sedimentary interbed at a depth of 73 meters (m) and then moves about 1.5 kilometers to the northweast beneath the RWMC. Infiltrating water can move clay, silt, and sand downward through sedimentary material and open fracturs, at least to the interbed at a depth of 73 m. Oxygen isotope exchange and clay mineral alteration caused by extruded lava have been observed in the upper 0.86 m of the sedimentary interbed at a depth of 34 m an in the upper 2.65 m of the sedimentary interbed at a depth of 73 m. An examination of the sediment-basalt interrelation shows that the flows overlying the interbed at a depth of 73 m are substantially thicker than the flows overlying the interbed at a depth of 34 m (16 to 23 m comapred to 6 to 10 m). Sedimentary material at the RWMC shows isotopic and soils evidence of at least two major climatic changes within the last 200,000 years. 65 refs., 18 figs., 19 tabs.

30034 **(DOE/ID/12576—T3) Projections of waste characteristics for the Midwest Compact region, 1985-2015: Regional management plan: Final report.** Frato, K.A.; Meckstroth, K.W. (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 11 Jul 1986. Contract FG07-85ID12576. 79p.

A critical step in determining future low-level waste facility needs in the region is development of region-wide waste projections. This report provides projections of low-level radioactive waste for a 30-year period, extending to the year 2015; the work is the result of Task 3 of an overall 6-task Management Plan development process. The base year for these projections is 1985 and is an estimate based on the best available data on current generation obtained in Task 2. 14 refs., 3 figs., 9 tabs.

30035 **(DOE/ID/12576—T5) Host state screening process: Regional management plan: [Final report].** Drobny, N.L. (ERM-Midwest, Inc., Columbus, OH (USA)). 29 Jul 1986. Contract FG07-85ID12576. 132p.

This report discusses the procedure and cirteria that the Commission selected for designating a host state, should a state not volunteer for this role. Section 2 describes the wide range of approaches considered. Advantages and disadvantages of each are reviewed briefly, and the overall timetable established by the Commission for host state selection is presented. Section 3 describes the selected process for host state designation which involves emphasis on waste quantities generated and transportation factors. Section 4 presents relevant data on characteristics of wastes presently generated and presents estimates for future waste generation to Year 2015. Section 5 presents the results of transportation analyses considering the distance over which waste would be transported and safety (accident) statistics for waste transport routes. Section 6 integrates the conclusions from the analysis of waste volumes generated and transportation factors and suggests how these results might be used to designate a host state. 11 refs., 6 figs., 9 tabs.

30036 **(DOE/ID/12576—T6) Summary report: Executive summary: Regional management plan: [Final report].** (Midwest Interstate Low-Level Radioactive Waste Commission, St. Paul, MN (USA)). 1 Aug 1986. Contract FG07-85ID12576. 6p.

K.

This summary report describes the results of a 16-month project to develop a Regional Management Plan for low-level radioactive waste management in a seven-state area. The seven states are Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. These states have formed the Midwest Interstate Low-Level Radioactive Waste Commission in accord with Congressional requirements established in 1980.

30037 **(DOE/ID/12576—T7) Screening criteria for siting waste management facilities: Regional management plan: [Final report].** Sutherland, A.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). 15 Jul 1986. Contract FG07-85ID12576. 85p.

The Midwest Interstate Low-Level Radioactive Waste Commission (Midwest Compact) seeks to define and place into operation a system for low-level waste management that will protect the public health and safety and the environment from the time the waste leaves its point of origin. Once the system is defined it will be necessary to find suitable sites for he components of that waste management system. The procedure for siting waste management facilities that have been chosen by the compact is one in which a host state is chosen for each facility. The host state is then given the freedom to select the site. Site swill be needed for low-level waste dispoal facilities. Depending on the nature of the waste management system chosen by the host state, sites may also be needed for regional waste treatment facilites, such as compactors or incinerators. This report provides example criteia for use in selecting sites for low-level radioactive waste treatment and disposal facilities. It is not, however, intended to constrain the host state in its choice of criteria or numerical values used in those criteria. 14 refs., 2 figs., 7 tabs.

30038 **(DOE/ID/12576—T8) Assessment of impacts from different waste treatment and waste disposal technologies: Regional Management Plan.** Robertson, B.C.; Sutherland, A.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA); ERM-McGlennon Associates, Boston, MA (USA)). 23 May 1986. Contract FG07-85ID12576. 89p. (RAE—8503/2-2).

This report presents assessments of treatment and disposal technologies that appear to be appropriate for use in regional facilities in the Midwest Compact Region. The treatment technologies assessed: compaction with a supercompactor; incineration; and incineration followed by solidfication of the incinerator ash. The disposal technologies assessed are: shallow land burial, considered a baseline for comparison of other technologies; below-ground vaults; abov-groudn vaults; the earth mounded concrete bunker, a technology developed in France; improved shallow land burial, essentially deeper burial; modular concrete canister disposal; mined cavities (both new and existing); and unlined augered holes; and lined augered holes. The teatment technologies are assessed primarily in terms of the their impact on the waste management system, and generally not comparatively. The dispoal technologies are assessed relative to the present standard practice shallow land burial; shallow land burial was slected as a frame of reference because it has an experience base spanning several decades, not because of any preferential characteristics. 20 refs., 5 tabs.

30039 **(DOE/ID/12576—T9) Assessment of waste characteristics and waste management practices for the Midwest compact region:.** Sutherland, A.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). 1 Jun 1986. Contract FG07-85ID12576. 65p.

To define that system and optimize its components, it is necessary to know various characteristics of the LLW generated in the Midwest Compact Region. It must have projections for the annual volumes from the states in the compact to determine the size and lifetimes of waste management facilities. Information on the different volumes of the region's LLW that fall into NRC waste classes will help determine volumes of waste that may need separate disposal. Eventually, licensing a LLW disposal facility will require source terms {emdash} quantities and concentrations of nuclides placed in the facility {emdash} in order to conduct performance assessments. To provide the information needed to make informed decisions about the nature and size of the Midwest region's low-level waste management system, information was gathered from a number of sources. The information was placed in a computer data base to preserve it and to facilitate extracton of combinations of data. This report describes how the information was assembled and the nature of the computerized data base. It also provides a baseline characterization of the low-level waste being generated and shipped for disposal from the Midwest region in the late 1980's. 10 refs., 7 figs., 13 tabs.

30040 **(DOE/ID/12576—T11) Identification of the recommended waste management systems and system development schedules: Regional management plan: [Final report].** Sutherland, A.A. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). 28 Jul 1986. Contract FG07-85ID12576. 108p.

During the past year the Midwest Compact Commission has studied alternatives for disposal and treatment, and the nature of the Midwest region's low-level radioactive waste, in order to narrow the spectrum of choices for the waste management system and its components. This report describes that process. The waste management system defined in this report stops short of prescribing a specific disposal technology. This is assumed to be largely the prerogative of the state that will host the disposal facility. Instead of a single disposal technology, four alternatives are recommended to the host state and the advantages and disadvantages of each are listed. 14 figs.

30041 **(DOE/ID/12638—T1) The University of Missouri Research Reactor facility can melter system.** Edwards, C.B. Jr.; Olson, O.L.; Stevens, R.; Brugger, R.M. (Missouri Univ., Columbia (USA). Research Reactor Facility). 30 Apr 1987. Contract FG07-86ID12638. 81p.

At the University of Missouri Research Reactor (MURR), a waste compacting system for reducing the volume of radioactive aluminum cans has been designed, built and put into operation. In MURR's programs of producing radioisotopes and transmutation doping of silicon, a large volume of radioactive aluminum cans is generated. The Can Melter System (CMS) consists of a sorting station, a can masher, an electric furnace and a gas fired furnace. This system reduces the cans and other radioactive metal into barrels of solid metal close to theoretical density. The CMS has been in operation at the MURR now for over two years. Twelve hundred cu ft of cans and other metals have been reduced into 150 cu ft of shipable waste. The construction cost of the CMS was $4950.84 plus 1680 man hours of labor, and the operating cost of the CMS is $18/lb. The radiation exposure to the operator is 8.6 mR/cu ft. The yearly operating savings is $30,000. 20 figs., 10 tabs.

30042 **(DOE/OR/21400—T337) Radioactive and hazardous chemical wastes: A challenge for the future: [Final report].** Wymer, R.G. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007258/JAW.

The author focuses attention on serious and widespread problems of environmental pollution, and points out that there are worthwhile problems to work on which are both important and professionally rewarding. A major opportunity exists to reduce the amounts of the wastes or to eliminate them at their sources by changing manufacturing methods or by developing new processes or products. However, there will always be wastes of some sort, and they must be dealt with.

30043 **(DOE-RW—8) Comparative assessment of environmental and socio-economic impacts of disposal of radioactive waste by shallow burial at sites identified by Nirex. Final report 1987. Vol. 1: study report. Vol. 2: annexe.** Gordon, A.E.M.; Morrow, A.J.; Watson, S.R. (Department of the Environment, London (UK)). Sep 1987. 255p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88752746/JAW.

This case study tested two methodologies, comparative assessment and multi-attribute value analysis, on repository site selection. Problems affecting their application stemmed from incomplete baseline and proposed project data and from the impacts being essentially indistinguishable between sites. The latter meant that initial screening was not possible and subsequent screening became arbitrary. The large number of impacts which had to be retained made handling difficult and meaningful rating under comparative assessment was virtually impossible without introducing implicit weightings and adjusting the scale. Multi-attribute value analysis, whilst the more data demanding of the two methodologies, has a greater capability for handling the impacts. Clearly, the limitations on what data can realistically be collected must be taken into account when the evaluation methodology is designed. Ideally a draft methodology should be applied to one site and modified as need be before used for the formal assessment.

30044 **(DOE-RW—87.064) Immobilization of radioactive waste in cement based matrices.** Glasser, F.P.; Rahman, A.A.; Macphee, S.; Atkins, M.; Beckley, N.; Carson, S. (Aberdeen Univ. (UK)). (Department of the Environment, London (UK)). Nov 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752747/JAW.

Experimental and theoretical studies of hydrated cement systems are described. The behaviour of slag-based cement is described with a view to predicting their long term pH, Esub(n) and mineralogical balance. Modelling studies which enable the prediction at long ages of cement composites are advanced and a base model of the $CaO\text{-}SiO_2\text{-}H_2O$ system presented. The behaviour of U and I in cements is explored. The tolerance of cement systems for a wide range of miscellaneous waste stream components and environmental hazards is described. The redox potential in cements is effectively lowered by irradiation.

30045 **(DOE-RW—87.103) 'WISP' a simple radioactive waste management computer program.** Beavan, G. (Department of the Environment, London (UK)). Dec 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753091/JAW.

The report describes the radioactive waste management program WISP. WISP was developed for rapid comparative assessment of different nuclear scenarios and fuel reprocessing strategies. It provides tables and graphs of low, intermediate and high level waste volumes from reactor operation, fuel reprocessing and station decommissioning (excluding Stage 3).

30046 **(DOE-RW—87.130) Background studies: human-induced effects on the evolution of shallow land burial sites for radioactive waste disposal.** (Department of the Environment, London (UK); Dames and Moore International, Twickenham (UK)). Nov 1987. 82p. (DM-TR—6). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753510/JAW.

This report presents the results of a programme of background research on the human-induced effects on the long term evolution of shallow disposal sites for low level radioactive wastes. The work is intended to support development and use of the TIME2 simulation code. Within the context of climatic change up to the next glacial maximum three areas are addressed: planning and legislative control over site usage, biosphere state changes and intrusion. An appendix presents a discussion of some planning aspects of radioactive waste disposal.

30047 **(DOE-RW—88.005) Optimization of waste management by actions taken at source. Final report.** Strachan, N.R.; Wakerley, M.W. (Associated Nuclear Services, Epsom (UK)). (Department of the Environment, London (UK); Associated Nuclear Services, Epsom (UK)). Jan 1988. 119p. (ANS-R—635-1). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753512/JAW.

The purpose of this document is to collate and review information on those measures and practices adopted within nuclear facilities to optimize the management of radioactive waste at the point of arising. The information on which it has been based has been obtained by literature review and by visits to a number of different types of facilities within the European Community. The search revealed mainly references to waste management optimization at US LWRs, whereas the visits have tried to cover as wide a range of European facilities as practicable. There are a number of different respects in which radioactive waste can be minimized: minimizing the amount of activity appearing in the wastes. This is best achieved by the design of process equipment; minimizing the volume of waste with which radioactivity is associated. This is best achieved by a combination of administrative controls and equipment design; minimizing the amount of material which for administrative or measurement reasons is considered to be radioactive. Many examples of minimization at source by means of equipment developments and administrative controls that were encountered during our visits or identified in the literature search are described.

30048 **(DOE-RW—88.008) Feasibility study of the application of biotechnology to nuclear waste treatment.** Ashley, N.V.; Pope, N.R.; Roach, D.J.W. (Department of the Environment, London (UK)). Dec 1987. 151p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753092/JAW.

A number of biotechnology areas applicable to the removal of radionuclides from industrial nuclear effluents were considered, namely: use of Biopolymers; Biosorption using biomass; microbial leaching and solubilisation of metal ions. The potential of biomagnetic separation technology, genetic engineering and monoclonal antibody technology was also examined. It appeared that the most appropriate technologies to develop for radionuclide removal in the short term were based on biosorptions of radionuclides by biomass and modified and unmodified biopolymers.

30049 **(DOE/RW—0160-Vol.1) Site characterization plan:.** (Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management). Jan 1988. Contract AC08-87NV10576. 754p. OSTI, PO Bx 62, Oak Ridge, TN 37831; H; GPO Dep. Order Number TI88007742/JAW.

The Yucca Mountain site in Nevada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared in acordance with the requirements of the Nuclear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site;to describe the conceptual designs for the repository and the waste package and to present the plans for obtaining the geologic information necessary to demonstrate the suitability of the site for a repository, to design the repository and the waste package, to prepare an environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. This introduction begins with a brief section on the process for siting and eveloping a repository, followed by a discussion of the pertinent legislation and regulations. A description of site characterization is presented next;it describes the facilities to be constructed for the site characterization program and explains the principal activities to be conducted during the program. Finally, the purpose, content, organizing prinicples, and organization of this site characterization plan are outlined, and compliance with applicable regulations is discussed. 880 refs., 130 figs., 25 tabs.

30050 **(DOE/RW—0160-Vol.4) Site characterization plan: Yucca Mountain site, Nevada research and development area, Nevada: Consultation draft, Nuclear Waste Policy Act: Volume 4.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jan 1988. Contract AC08-87NV10576. 854p.

The Yucca Mountain site in Nevada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended and approved by the President for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared in accordance with the requirements of the Nuclear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site; to describe the conceptual designs for the repository and the waste package; and to present the plans for obtaining the geologic information necessary to demonstate the suitability of the site for a repository, to desin the repository and the waste package, to prepare an environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. This introduction begins with a brief section on the process for siting and developing a repository, followed by a discussion of the pertinent legislation and regulations. A description of site characterization is presented next; it describes the facilities to be constructed for the site characterization program and explains the principal activities to be conducted during the program. Finally, the purpose, content, organizing principles, and organization of this site characterization plan are outlined, and compliance with applicable regulations is discussed.

30051 **(DOE/RW—0160-Vol.5) Site characterization plan: Yucca Mountain site, Nevada research and development area, Nevada: Consultation draft, Nuclear Waste Policy Act.** (Department of Energy, Washington, DC (USA). Office of Nuclear Waste Management). Jan 1988. Contract AC08-87NV10576. 854p. H; GPO Dep. Order Number DE88007746/JAW.

The Yucca Mountain site in Nevada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended by the Secretary of Energy and approved by the President for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared by the US Department of Energy (DOE) in accordance with the requirements of the Nulcear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site;to describe the conceptual designs for the repository and the waste package;and to present the plans for obtaining the geologic information necessary to demonstrate the suitability of the site

for a repository, to design the repository and the waste package, to prepare an environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. This introduction begins with a brief section on the process for siting and developing a repository, followed by a discussion of the pertinent legislation and regulations. A description of site characterization is presented next;it describes the facilities to be constructed for the site characterization program and explains the principal activities to be conducted during the program. Finally, the purpose, content, organizing principles, and organization of the site characterization plan are oulined, and compliance with applicable regulations is discussed.

30052 **(DOE/RW—0160-Vol.6) Site characterization plan:.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jan 1988. Contract AC08-87NV10576. 802p.

The Yucca Mountain site in Nevada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared in accordance with the requirements of the Nuclear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site;to describe the conceptual designs for the repository and the waste package;and to present the plans for obtaining the geologic information necessary to demonstrate the suitability of the site for repository, to design the repository and the waste package, to prepare an environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. This introduction begins with a brief section on the process for siting and developing a repository, followed by a discussion of the pertinent legislation and regulations. A description of site characterization is presented next;it describes the facilities to be constructed for the site characterization program and explains the principal activities to be conducted during the program. Finally, the purpose, content, organizing principles, and organization of this site characterization plan are outlined, and compliance with applicable regulations is discussed.

30053 **(DOE/RW—0160-Vol.7) Site characterization plan: Yucca Mountain site, Nevada research and development area, Nevada: Consultation draft, Nuclear Waste Policy Act: Volume 7.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jan 1988. Contract AC08-87NV10576. 847p. H; 1; GPO Dep. Order Number TI88007748/JAW.

The Yucca Mountain site in Neavada is one of three candidate sites for the first geologic repository for radioactive waste. On May 28, 1986, it was recommended and approved for detailed study in a program of site characterization. This site characterization plan (SCP) has been prepared in accordance with the requirements of the Nuclear Waste Policy Act to summarize the information collected to date about the geologic conditions at the site;to describe the conceptual designs for the repository and the waste package;and to present the plans for obtaining hte geologic information necessary to demonstrate the suitability of the site for a repository, to design the repository and the waste package, to prepare and environmental impact statement, and to obtain from the US Nuclear Regulatory Commission (NRC) an authorization to construct the repository. This introduction begins with a brief section on the process for siting and developing a repository, followed by a discussion of the pertinent legislation and regulations. A description of site characterization is presented next;it describes the facilities to be constructed for the site characterization program and explains the principal activities to be conducted during the program. Finally, the purpose, content, organizing principles, and organization of this site characterization plan are outlined, and compliance with applicable regulations is discussed.

30054 **(DOE/RW—0176-Rev.1-Draft) Environmental Monitoring and Mitigation Plan for site characterization:.** (USDOE Nevada Operations Office, Las Vegas). Jan 1988. Contract AC08-87NV10576. 161p.

The DOE is committed to conduct its operations in an environmentally safe and sound manner, and will comply with the letter and the spirit of applicable environmental statues and regulations. This document - the NNWSI Project's Environmental Regulatory Compliance Plan (ERCP) - is one means of implementing the policy. The ERCP describes the plan by which the NNWSI Project Office will comply with applicable environmental statutes and regulations. The ERCP also discusses how DOE will address State and local environmental statues and regulations. To achieve the goals of DOE, the ERCP will be developed in phases. This version of the ERCP is the first phase in this development. It represents the NNWSI Project's understanding of environmental regulatory requirements for site characterization of Yucca Mountain. After consultation with appropriate Federal and State agencies, the ERCP will be updated to reflect the results of these consultations. 29 figs., 1 tab.

30055 **(DOE/RW—0179) Socioeconomic monitoring and mitigation plan for site characterization: Revision 1.** (USDOE Nevada Operations Office, Las Vegas). Jan 1988. Contract AC08-87NV10576. 147p. OSTI, PO Bx 62, Oak Ridge, TN 37831; H; GPO Dep. Order Number DE88006890/JAW.

The objective of the SMMP is to document compliance with the NWPA. In order to do so, a summary description of site characterization activities based on the consultation draft of the Site Characterization Plan and the final EA is provided. Subsequent chapters identify issues related to the potential for significant adverse impacts and the monitoring plans proposed to determine whether those impacts occur. Should monitoring confirm the potential for significant adverse impact, mitigative maesures will be developed. In the context of site characterization, mitigation is defined as those changes in site characterization activities that serve to avoid or minimize, to the maximum extent practicable, any significant adverse environmental impacts. Proposed site characterization activites involve a variety of surface and subsurface activities including site preparation, access road construction and improvment, exploratory drilling and testing, geophysical surveys, geological mapping, and construction of the exploratory shaft facility. It is not anticipated that any significant adverse socioeconomic impacts will result form any of the proposed site characterization activities. However, the assessment of impacts in the EA, especially impacts related to employment and population growth, was based on assumptions concerning activities and conditions during the site characterization phase.

30056 **(DOE/RW—0184-Vol.1) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 290p.

The purpose of this report, and the information contained in the associated computerized data bases, is to establish the DOE/OCRWM reference characteristics of the radioactive waste materials that may be accepted by DOE for emplacement in the mined geologic disposal system. This report provides relevant technical data for use by DOE and its supporting contractors and is not intended to be a policy document. This document is backed up by five PC-compatible data bases, written in a user-oriented, menu-driven format, which were developed for this purpose. The data bases are the LWR Assemblies Data Base; the LWR Radiological Data Base; the LWR Quantities Data Base; the LWR NFA Hardware Data Base; and the High-Level Waste Data Base. The above data bases may be ordered using the included form. An introductory information diskette can be found inside the back cover of this report. It provides a brief introduction to each of these five PC data bases. 116 refs., 18 figs., 67 tabs.

30057 **(DOE/RW—0184-Vol.6) Characteristics of spent fuel, high-level waste, and other radioactive wastes which may require long-term isolation: Appendix 3A, ORIGEN2 decay tables for immobilized high-level waste, Appendix 3B, Interim high-level waste forms, Appendix 3C, User's guide to the high-level waste PC data base.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Dec 1987. 239p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88007364/JAW.

The purpose of this report, and the information contained in the associated computerized data bases, is to establish the DOE/OCRWM reference characteristics of the radioactive waste materials that may be accepted by DOE for emplacement in he mined geologic disposal system. This report provides relevant technical data for use by DOE and its supporting contractors and is not intended to be a policy document. This document is backed up by five PC-compatible data bases, written in a user-oriented, menu-driven format, which were developed for this purpose. The data bases are the LWR Assemblies Data Base; the LWR Radiological Data Base; the LWR Quantities Data Base; the LWR NFA Hardware Data Base; and the High-Level Waste Data Base. The above data bases may be ordered using the included form. Volume 6 contains decay tables for immobilized high-level waste, information on interim high-level waste forms, and a user's guide to the high-level waste PC data base.

30058 **(DOE/RW—0188) Office of Civilian Radioactive Waste Management quarterly report on program cost and schedule, first quarter FY 1988.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). 1988. 32p.

This report is intended to provide a summary of the cost and schedule performance for the civilian radioactive waste management program. Performance data are presented for each of the major program elements. Also included in this report is the status of the Nuclear waste Fund revenues and disbursement. This report includes performance data through December 1987. In December 1987, Congress passed the Nuclear Waste Policy Amendments Act of 1987 which changed the near-term activities of the program. Specifically, This Act required that the tuff site in Nevada be characterized for the first repository and that site-specific activities at the other two first repository sites (the salt site in Texas and the basalt site in Washington) be terminated within 90 days of enactment. The Act also requires the phase-out of all second repository activities designed to evaluate the suitability of crystalline rock as a potential host rock for a repository. The new legislation impacts the contents of this report by focusing the first repository program on the activities of the tuff project and phasing-out the activities for the salt, basalt and second repository projects.

30059 **(DP—86-125-3/4) Waste management program: Technical progress report, July-December 1986.** (BE, Inc., Barnwell, SC (USA)). Mar 1988. Contract AC09-76SR00001. 25p.

This report provides information on the status of plant operations and research and development programs for the management of radioactive wastes at the Savannah River Plant. This technical progress report consist of discussions on long-term waste management. The research and development program in support of interim tank storage of liquid and crystallized plant waste comprises: (1) analysis of the present tank system; (2) development of improved processes and equipment; (3) corrosion studies; and (4) analysis of environmental effects. In the reference design process for high-level waste at the Savannah River Plant, the salt currently in storage tanks will be dissolved, and the resulting solution will be decontaminated. More than 99% of the ^{137}Cs and residual ^{90}Sr will be removed. The decontaminated liquid will be mixed with cement to form a grout that contains only a small fraction of the total hazardous radioactive material. The "Saltstone" grout will be disposed of onsite in an engineerred landfill. Sludge, which has been treated in the waste tanks to remove soluble aluminum compounds and soluble salts, will be combined with the recovered radionuclides from the salt solution, mixed with glass frit and fed to a glass melter. The combined radionuclides from the salt and sludge will be incorporated into borosilicate glass and sealed in canisters for shipment to a federal repository. The Defense Waste Processing Facility (DWPF) is being designed to incorporate the Savannah River Plant (SRP) defense waste into borosilicate glass using this process.

30060 **(DP-MS—87-151) Demonstration of a steam jet scrubber off-gas system and the burner efficiency of a mixed waste incinerator facility.** Holmes, H.; Charlesworth, D.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 10p. (CONF-880526—2).

From International conference on incineration of hazardous and radioactive waste; San Francisco, CA, USA (3 May 1988).

A full-scale incinerator system, the Consolidated Incineration Facility (CIF), is being designed to process solid and liquid low-level radioactive, mixed, and RCRA hazardous waste. This facility will consist of a rotary kiln, secondary combustion chamber (SCC), and a wet off-gas system. A prototype steam jet scrubber off-gas system has been tested to verify design assumptions for the CIF. The scrubber wastewater will be immobilized in a cement matrix after the blowdown has been concentrated to a maximum solids concentration in a cross-flow filtration system. A sintered metal inertial filter system has been successfully tested. Burner efficiency was tested in a high intensity vortex burner, which destroyed the hazardous waste streams tested.

30061 **(DP-MS—88-14) Control of radioactive waste-glass melters: Part 3, Glass electrical stability.** Bickford, D.F.; Propst, R.C.; Plodinec, M.J. (Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 21p. (CONF-880590—1).

From Advances in fusion of glass meeting; Cincinnati, OH, USA (1 May 1988).

Pilot waste-glass melter operations have indicated a tendency for noble-metal fission-product accumulation on melter floors, which can lead to distortion of electric heating patterns, and decrease melter life. Changes in melter geometry are being considered in Japan, Germany, and the United States to permit draining of the noble metals to reduce their effects. Physical modeling of melter electrical patterns, electrode/waste-glass electrochemistry, and nonlinear electrical behavior have been evaluated for typical waste-glass. Major melter design changes should not be necessary for the US Department of Energy's Defense Waste Processing Facility (DWPF). Top electrodes will not be significantly affected. Minor alterations in melter design, monitoring of electrical characteristics, and adjustment of bottom electrode currents can provide protection from shorting if noble metals accumulate. 31 refs., 4 figs., 4 tabs.

30062 **(EGG-M—31186) Regional LLRW [low-level radioactive waste] processing alternatives applying the DOE REGINALT systems analysis model.** Beers, G.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 5p. (CONF-870306—74).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The DOE Low-Level Waste Management Progam has developed a computer-based decision support system of models that may be used by nonprogrammers to evaluate a comprehensive approach to commercial low-level radioactive waste (LLRW) management. REGINALT (Regional Waste Management Alternatives Analysis Model) implementation will be described as the model is applied to a hypothetical regional compact for the purpose of examining the technical and economic potential of two waste processing alternaties. Using waste from a typical regional compact, two specific regional waste processing centers will be compared for feasibility. Example 1 will assume will assume that a regional supercompaction facility is being developed for the region. Example 2 will assume that a regional facility with both supercompation and incineration is specified. Both examples will include identical disposal facilities, except that capacity may differ due to variation in volume reduction achieved. The two examples will be compared with regard to volume reduction achieved, estimated occupational exposure for the processing facilities, and life cylcle costs per generated unit waste. A base case will also illustrate current disposal practices. The results of the comparisons will be evaluated, and other steps, if necessary, for additional decision support will be identified.

30063 **(EPRI-NP—5671) Below Regulatory Concern Owners Group:.** Smith, C.F.;Phillips, L.B.;Williams, W.J. (Science Applications International Corp., Pleasanton, CA (USA)). Mar 1988. 103p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920252/JAW.

The US Nuclear Regulatory Commission has indicated that Below Regulatory Concern (BRC) exemption of waste streams from the disposal requirements for low level radioactive waste should be based on actual expected nuclide concentration and variability. Because of variations in the importance and relative abun-

dance of nuclides in waste, one or a small number of nuclides may control the detemination of a waste steam as BRC. This study wasconducted to evaluate the relative importance of the major radionucldies in dose assessments for the disposal options and geographic regions under consideration for BRC waste. 6 refs., 25 tabs.

30064 **(EPRI-NP—5672) Below Regulatory Concern Owners Group: Selection of plants for sampling program: Final report.** Vance, J.N. (Vance and Associates, Ruidoso, NM (USA)). Mar 1988. 47p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920254/JAW.

This report is one of a series of reports in the EPRI Below Regulatory Concern (BRC) program. This study was performed to provide the selection basis for plants to be included in the BRC sampling program. This final report describes the evaluations performed using 10CFR61 data and current fuel performance data to identify those plants with larger quantities of tramp or exposed fuel and correspondingly higher transuranic levels in the plant waste streams. Plants were ranked from the highest level to the lowest level of exposed or tramp fuel in the core. 10 tabs.

30065 **(EUR—11046-Vol.1) Study of dissolution precipitation phenomena related to heat generated by underground disposal. Vol 1. Comparison with active hydrothermalism.** Fabriol, R. (Commission of the European Communities, Luxembourg). 1987. 26p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753063/JAW.

This study is composed of two parts developed in two separated volumes. The first part is a bibliographical research concerning the behaviour of waste analog elements during hydrothermal alteration in active geothermal fields. The second part is an experimental and theoretical simulation of dissolution-precipitation phenomena related to heat generated in the vicinity of a nuclear waste repository located in granitic formations. This work is part of the CEC project MIRAGE on natural geological migration systems.

30066 **(EUR—11077) Contribution to hydrogeological investigations related to the disposal of radioactive wastes in a deep argillaceous formation.** Patijn, J. (Commission of the European Communities, Luxembourg). 1987. 172p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753066/JAW.

The study deals with the development of a methodology in order to evaluate the capability of an aquifer system to be used for the disposal of radioactive wastes in deep argillaceous formations. The first part is concerned with hydrogeological investigations of a sedimentary basin. The second part is concerned with flow simulation using NEWMAN model. The limited influence of some possible geological events on radionuclide transfer is emphasized.

30067 **(FMPC—2102) Biological treatment of nitrate bearing wastewaters from a uranium production plant.** Benear, A.K.; Kneip, R.W. Jr. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1988. Contract AC05-86OR21600. 10p. (CONF-880201—13).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The Feed Materials Production Center (FMPC) produces uranium metal products used for DOE defense programs resulting in the generation of nitrate-bearing wastewaters. To treat these wastewaters, a two-column fluidized bed biodenitrification facility (BDN) was constructed at the FMPC. The operation of the BDN resulted in substantial compliance with the design criteria limits for nitrate from July through November, 1987. Since the BDN surge lagoon (BSL) proved inadequate for providing nitrate concentration equalization, the BDN feed nitrate concentration fluctuated widely throughout this period of operation. BDN effluent caused a doubling of the hydraulic loading and a tripling of the organic loading on the FMPC sewage treatment plant (STP). Better control of the methanol feed to the BDN, coupled with reduced throughput and improved preaeration, caused a significant improvement in the operation of the STP. The overloading of the STP prompted a decision to add a stand-alone effluent treatment system to the BDN. Preliminary screening tests show that the BDN effluent contains fecal coliforms which will necessitate the disinfection of the final effluent prior to discharge. 2 refs., 7 figs., 1 tab.

30068 **(FRNC-TH—3198) Mechanisms of hydrothermal alteration in a granitic rock. Consequences for high-level radioactive waste disposal.** Parneix, J.C. (Paris-6 Univ., 75 (France)). Jun 1987. 219p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753071/JAW.

The study of hydrothermal alteration in the Auriat granitic rock (France, Massif-Central) has evidenced three main events: - a pervasive chloritisation of biotites in some parts of the drill-core, - an alteration localized around subvertical cracks and superimposed on previously chloritized or unaltered granite, - an alteration localized around subhorizontal cracks cross-cutting the preceding ones. The second type of alteration, produced by a geothermal system, gives the most interesting results to be applied to the nuclear radwaste disposal problem. Among primary minerals of granite, only biotite (or chlorite) and oligoclase are intensively altered. Therefore, the chemical composition of these minerals induces the nature of secondary parageneses. These, associated to the subvertical cracks network, indicate a thermal gradient of 150 C/Km. The geochemical code has allowed to corroborate that the thermal gradient was responsible for the occurrence of different parageneses with depth. Moreover, it was shown that the variable mineralogy around cracks was due to a thermal profile established at equilibrium between the rock and the fluid. Therefore, the extent of the alteration was proportional to the thermal power of the fluid. A dissolution and next a precipitation phase of new minerals characterize hydrothermal alteration, which is due to the thermal power emitted by radioactive waste and linked with the evolution of temperature during time. This alteration provokes two favourable events to storage: decrease of rock porosity and increase of sorption capacity.

30069 **(GSF—12/87) In-situ permeability measurements in the bedrock surrounding underground cavities, using th example of Konrad mine.** Haensel, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung). 1987. 79p. (In German). (GSF-TL—24/87). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753540/JAW.

When assessing the safety of underground storage sites, the permeability of the system and the surrounding bedrock is of utmost importance. Permeability data were determined by a pressure-pulse method combined with a modified LUGEON test using gases.

30070 **(GSF—35/86) Experimental investigations of radionuclide migration in the vicinity of the projected final storage site for radioactive waste in Konrad mine. Investigation program II.** Klotz, D.; Lang, H.; Moser, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie). 1986. 73p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753543/JAW.

The transport of radionuclides from the planned final storage site at Konrad mine into the biosphere was investigated in laboratory experiments. Crushed rock samples from the K 101 experimental borehole were analyzed in flow column batch, and diffusion experiments using Cs^+, I^-, CO_3^{2-}, and natural groundwater or groundwater made up according to analytical data. Compared with groundwater transport, transport through rock involves a delay which depends on the type of solid samples and on the salt concentration in the groundwater. The results of the diffusion experiments suggest that a delay in transport must be expected even with low-sorption ions.

30071 **(INIS-GB—130) Your radioactive garden. Nuclear waste in perspective.** Marshall, W.G. (Central Electricity Generating Board, London (UK)). 1986. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753514/JAW.

The booklet on radiation risks from nuclear waste is based on lectures given by the author at Westminster School (United Kingdom) and elsewhere during 1986. A description is given of

naturally-occurring radioactivity, and the health risks due to this radiation. The types of radioactive wastes produced by the nuclear industry are described, including low-level wastes, short-lived and long-lived intermediate-level wastes, and high level wastes. These wastes are discussed with respect to their potential health risks and their disposal underground. (U.K.).

30072 **(INIS-XN—8) Orders of 17 September 1984 approving special form radioactive materials in sealed sources.** (Nuclear Energy Agency, 75 - Paris (France)). 23 Nov 1984. 1p. (In French).

These Orders approve certain types of special form radioactive material in sealed sources and provide that when spent, such sources will be collected on request and disposed of in an approved facility by the competent services of the Atomic Energy Commission or an authorized company.

30073 **(LA—11023-MS) Smectite dehydration and stability: Applications to radioactive waste isolation at Yucca Mountain, Nevada.** Bish, D.L. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 32p.

Montmorillonite-beidellite smectites are present in amounts up to 50% in the rocks directly underlying the potential high-level radioactive waste repository horizon at Yucca Mountain, Nevada. The thermal reactions of concern include reversible collapse/expansion of the smectite layers due to loss/gain of interlayer water;irreversible collapse due to loss of interlayer water and migration of interlayer cations into the 2:1 silicate layers;irreversible reduction of the osmotic swelling ability through reaction in a steam atmosphere;and inhomogeneous transformation of the smectite into an interstratified illite/smectite. Reversible collapse should be of minor importance because any thermally driven collapse will be reversed when water is introduced and temperatures go down. The amounts of smectite in the potential repository horizon itself are probably insufficient to give rise to rock strength problems due to reversible collapse. The irreversible reduction of somotic selling capacity in a steam environment may be significant in the rocks near the repository horizon. This effect on naturally occurring Na-rich smectites would probably increase permeabilitie shut would also provide for increased cation exchange by the smectite. 60 refs., 9 figs.

30074 **(LBL—23641) The role of chemical reaction in waste-form performance.** Chambre, P.L.; Kang, C.H.; Lee, W.W.L.; Pigford, T.H. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 11p. (CONF-8711100—9).

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

The dissolution rate of waste solids in a geologic repository is a complex function of waste form geometry, chemical raction rate, exterior flow field, and chemical environment. We present here an analysis to determine the stady-state mass transfer rate, over the entire range of flow conditions relevant to geologic disposal of nuclear waste. The equations for steady-state mass transfer with a chemical-reaction-rate boundary condition are solved by three different mathematical techniques which supplement each other. This theory is illustrated with laboratory leach data for borosilicate-glass and a spherical spent-fuel waste form under typical repository conditions. For borosilicate glass waste in the temperature range of 57{degree}C to 250{degree}C, dissolution rate in a repository is determined for a wide range of chemical reaction rates and for Peclet numbers from zero to well over 100, far beyond any Peclet values expected in a repository. Spent-fuel dissolution in a repository is also investigated, based on the limited leach data now available. 10 refs., 4 figs., 1 tab.

30075 **(LBL—23689) Near-field mass transfer in geologic disposal systems: A review.** Pigford, T.H.; Chambre, P.L. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 20p. (CONF-8711100—8; UCB-NE—4106).

From Symposium on the scientific basis for nuclear waste management; Boston, MA, USA (30 Nov 1987).

A primary purpose of performance assessment of geologic repositories for radioactive waste is to predict the extent to which radioactive species are released from the waste solids and are transported through geologic media to the environment. Reliable quantitative predictions must be made of rates of release of radionuclides from the waste into the rock, transport through the geologic media, cumulative release to the accessible environment, and maximum concentrations in ground water and surface water. Here we review theoretical approaches to making the predictions of near-field release from buried waste solids, which provide the source terms for far-field release. The extent to which approaches and issues depend on the rock media and on regulatory criteria is discussed. 53 refs., 2 figs.

30076 **(LBL—24599) Mass transfer and transport in geologic repositories: Analytical studies and applications.** Pigford, T.H.; Chambre, P.L.; Lee, W.W.L. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 8p. (UCB-NE—4120; CONF-880601—19; CONF-880601—).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Assessing the long-term performance of geologic repositories for radioactive waste requires reliable quantitative predictions of rates of release of radionuclides from the waste into the rock, transport through the geologic media, cumulative release to the accessible environment, and maximum concentrations in ground water and surface water. Here we review theoretical approaches to making these predictions and issues that require resolution. 27 refs.

30077 **(LBL—24751) Tracer travel time and model validation.** Tsang, Chin-Fu. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 5p. (CONF-880601—29). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007410/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The performance assessment of a nuclear waste repository demands much more in comparison to the safety evaluation of any civil constructions such as dams, or the resource evaluation of a petroleum or geothermal reservoir. It involves the estimation of low probability (low concentration) of radionuclide transport extrapolated 1000's of years into the future. Thus models used to make these estimates need to be carefully validated. A number of recent efforts have been devoted to the study of this problem. Some general comments on model validation were given by Tsang. The present paper discusses some issues of validation in regards to radionuclide transport. 5 refs.

30078 **(NUREG—1249-Vol.1) NRC model simulations in support of the hydrologic code intercomparison study (HYDROCOIN): Level 1-code verification.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Mar 1988. 183p. NTIS, PC A09/MF A01; GPO Dep. Order Number TI88900619/JAW.

HYDROCOIN is an international study for examining ground-water flow modeling strategies and their influence on safety assessments of geologic repositories for nuclear waste. This report summarizes only the combined NRC project temas' simulation efforts on the computer code bench-marking problems. The codes used to simulate thesee seven problems were SWIFT II, FEMWATER, UNSAT2M USGS-3D, AND TOUGH. In general, linear problems involving scalars such as hydraulic head were accurately simulated by both finite-difference and finite-element solution algorithms. Both types of codes produced accurate results even for complex geometrics such as intersecting fractures. Difficulties were encountered in solving problems that invovled nonlinear effects such as density-driven flow and unsaturated flow. In order to fully evaluate the accuracy of these codes, post-processing of results using paricle tracking algorithms and calculating fluxes were examined. This proved very valuable by uncovering disagreements among code results even through the hydraulic-head solutions had been in agreement. 9 refs., 111 figs., 6 tabs.

30079 **(NUREG/CR—4918-Vol.2) Control of water infiltration into near surface LLW disposal units: Task report, A discussion.** Schulz, R.K.; Ridky, R.W.; O'Donnell, E. (California Univ., Berkeley (USA). Dept. of Plant and Soil Biology; Maryland Univ., College Park (USA). Dept. of Geology; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). Mar 1988. 31p.

The principal pathway for water entry into LLW disposal units in the humid eastern United States is through their covers. Two types of sub-surface features that may be constructed to enhance run-off (surface or sub-surface run-off) and thus reduce percolation are the resistive layer barrier, and the conductive layer barrier. The resistive layer barrier is the compacted soil or compacted clay layer and depends on compaction of permeable porous material to obtain low flow rates. The conductive layer barrier is a special case of the capillary barrier. Use is made of the capillary barrier phenomenon not only to increase the moisture content above an interface but to divert water away from the waste. During such diversion the water is at all times at negative capillary potential or under tension in the flow layer. A very effective barrier system might be constructed by placing a resistive barrier over a conductive barrier. Such a system must fail if appreciable subsidence takes place. An alternate procedure called bioengineering management utilizes engineered features at the surface (as opposed to the subsurface) to ensure adequate run-off. The engineered features are combined with stressed vegetation, that is, vegetation in an overdraft condition, to control deep percolation. (59 refs., 10 figs.)

30080 **(NUREG/CR—5107) Hydrogeologic characterization of basalts: The northern rim of the Columbia Plateau Physiographic Province and of the Creston Study Area, eastern Washington.** Steele, T.D.; Paschis, J.A.; Koenig, R.A. (In-Situ, Inc., Laramie, WY (USA)). Mar 1988. 240p.

This report provides a general but comprehensive characterization of hydrogeologic and hydrogeochemical baseline conditions for the Creston area located along the northern rim of the Columbia Plateau physiographic province. Historical as well as recent data and other available information from previous studies and alternative sources have been considered in this baseline hydrological characterization. These include data and information on water levels, aquifer characteristics, and water quality for shallow basalt units comprising the Wanapum Formation and the Grande Ronde Formation in the Creston study area and for the general region surrounding this study area. The overall goal of this hydrologic characterization was to provide useful information leading to the selection of the Roza Member of the Wanapum Formation as the study's basalt horizon and for other related, subsequent study components of In-Situ's research project. 110 refs., 52 figs., 25 tabs.

30081 **(ORNL/TM—10652) An evaluation of supercompaction of drums containing solid low-level waste from Oak Ridge National Laboratory.** Kennerly, J.M.; Rivera, A.L.; Morrow, R.W.; Williams, L.C. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 58p.

Supercompaction and grouting technologies were demonstrated with solid LLW from Oak Ridge National Laboratory at the solid Waste Storage Area 5 (SWSA 5). The subcontractor used its mobile supercompaction system operating at 220 tons of compressive force to volume reduce 300 55-gal drums of solid LLW. The supercompaction of these drums resulted in a disposal capacity savings of about 85% of the original disposal capacity needs. The packaging of the compacted drums into 47 overpacks decreased the disposal capacity savings by about 19%. The net disposal capacity savings from the demonstration project is about 66% of the original, uncompacted waste volume. Based on the approximately $95K in direct costs, the supercompaction of the 2304 ft^3 of waste processed cost about 41ft^3$ of uncompacted waste. Once the supercompaction unit was set up and operating, the incremental cost for the supercompaction services was only about 4ft^3$. The economic assessment for this project revealed that the cost-effectiveness of on-site demonstrations is very sensitive to the on-site support (non-vendor-related) costs. The minimum disposal costs for cost-effectiveness in this demonstration project was calculated to be about 18ft^3$ for no on-site support costs and about 180ft^3$ when the on-site support costs represented about 90% of the total demonstration project cost. (2 refs., 14 figs., 9 tabs.)

30082 **(ORNL/TM—10661) Pulsatile fluidic pump performance at elevated temperatures.** Morgan, J.G.; Holland, W.D. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 25p.

A series of tests were conducted to evaluate the performance of a pulsatile fluidic pump operating with simulated fuel solution at high temperatures. A computer program was written to model the performance of the system. Test results indicate little change in pump peformance at temperatues up to the boiling point of the solution. The computer model predicted pumping system performance within 10 to 20% depending on the pump motivation pressure. 7 refs., 5 figs.

30083 **(ORNL/TM—10737) Waste management system functional requirements for Interim Waste Management Facilities (IWMFs) and technology demonstrations, LLWDDD [Low-Level Disposal Development and Demonstration] Program.** (Automated Sciences Group, Inc., Oak Ridge, TN (USA)). Mar 1988. Contract AC05-84OR21400. 51p.

The purpose of this report is to build upon the preceding decisions and body of information to prepare draft system functional requirements for each classification of waste disposal currently proposed for Low-Level Waste Disposal Development Demonstration (LLWDDD) projects. Functional requirements identify specific information and data needs necessary to satisfy engineering design criteria/objectives for Interim Waste Management Facilities. This draft will suppor the alternatives evaluation process and will continue to evolve as strategy is implemented, regulatory limits are established, technical and economic uncertainties are resolved, and waste management plans are being implemented. This document will become the planning basis for the new generation of solid LLW management facilities on new sites on the Reservation. Eighteen (18) general system requirements are identified which are applicable to all four Low-Level Waste (LLW) disposal classifications. Each classification of LLW disposal is individually addressed with respect ot waste characteristics, site considerations, facility operations, facility closure/post-closure, intruder barriers, institutional control, and performance monitoring requirements. Three initial LLW disposal sites have been proposed as locations on the ORR for the first demonstrations.

30084 **(PNL—6245) Geother evaluntion and improvement: A progress report including test cases for two-dimensional BWIP [Basalt Waste Isolation Project] analysis.** Bian, S.H.; Budden, M.J.; Bartley, C.L.; Yung, S.C. (Pacific Northwest Lab., Richland, WA (USA); Westinghouse Hanford Co., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 391p.

The objective of the work is to evaluate the GEOTHER code and peform necessary improvements to make it specifically suitable for predicting the environmental conditions of the waste package for the Basalt Waste Isolation Project (BWIP); and to perform resaturation analyses, that is, the analyses of steam formation and condensation, for the repository and waste package using the improved GEOTHER code. This is a progress report to BWIP documenting the status of GEOTHER code testing, evaluation, and improvements. The computational results documented in this report reflect the current condition of the code and the condition before code improvements. The test cases used are intended for examining the code features in sufficient detail and are not intended to be taken as final conclusions for BWIP applications.

30085 **(PNL—6465-Vol.1) Ground-water monitoring compliance projects for Hanford Site facilities: Volume 1, The report and Appendix A, Progress report for the period October 1 to December 31, 1986.** (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88007369/JAW.

This report documents recent progress on ground-water monitoring projects for four Hanford Site facilities: the 300 Area Process Trenches, the 183-H Solar Evaporation Basins, the 200 Area Low-Level Burial Grounds, and the Nonradioactive Dangerous Waste (NRDW) Landfill. The existing ground-water monitoring projects for the first two facilities named in the paragraph

above are currently being expanded by adding new wells to the networks. During the reporting period, sampling of the existing wells continued on a monthly basis, and the analytical results for samples collected from September through November 1986 are included and discussed in this document. 8 refs., 41 figs., 7 tabs.

30086 **(PNL—6467-Vol.2) Ground-water monitoring compliance projects for Hanford Site facilities: Volume 2, Appendices A and B: Progress report, January 1, 1987 to March 31, 1987.** (Pacific Northwest Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-76RL01830. 763p. NTIS, PC A; 99; GPO Dep. Order Number DE88007580/JAW.

This report convers recent progress on ground-water monitoring programs for four Hanford Site facilities: the 300 Area Process Trenches, the 183-H Solar Evaporation Basins, the 200 Area Low-Level Burial Grounds, and the Nonradioactive Dangerous Waste Landfill. The time period covered by this report is January 1 to March 31, 1987. Volume 2 contains Appendices A and B.

30087 **(PNL—6468) Ground-water monitoring compliance projects for Hanford Site Facilities: Progress report for the period April 1 to June 30, 1987.** (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 204p. NTIS, PC A; 10; GPO Dep. Order Number DE88007418/JAW.

This report documents the progress of four Hanford Site ground-water monitoring projects for the period from April 1 to June 30, 1987. The four disposal facilities are the 300 Area Porcess Tranches, 183-H Solar Evaporation Basins, 200 Area Low-Level Burial Grounds, and Nonradioactive Fangerous Waste (NRDW) Landfill. This report is the fourth in a series of periodic status reports. During this reporting period, three Phase III monitoring wells were completed and added to the rountine ground-water monitoring network at 183-H. An interim site characterization report for 183-H was completed and submitted to the state and the USEPA. The NRDW Landfill interim characterization report is in the final stages of clearance and the 300 Area report is in the review process. A drilling contract for 19 wells located around the 200 West Area Burial Grounds was awarded to ONWEGO Well Drilling in May 1987. Kaiser Engineers Hanford (KEH) was given approval to purchase four cable tool drilling rigs and complete the 16 wells located around the 200 East Area Burial Grounds. Drilling in both the East and West Areas was initiated during this reporting period. Analytical results for the three sites for which wells have been drilled indicate no deviations from previously established trends. Results from the NRDW Landfill indicates that the facility has no effect on the ground-water quality beneath the facility. Fluctuations in concentrations of specific parameters at the 300 Area site are generally attributed to specific activities conducted in the 300 Area. 1 ref., 36 figs., 6 tabs.

30088 **(PNL—6470) Revised ground-water monitoring compliance plan for the 183-H Solar Evaporation Basins.** (Pacific Northwest Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76RL01830. 444p.

This document contains ground-water monitoring plans for a mixed waste storage facility located on the Hanford Site in southeastern Washington State. This facility has been used since 1973 for storage of mixed wastes, which contain both chemicals and radionuclides. The ground-water monitoring plans presented here represent revision and expansion of an effort in June 1985. At that time, a facility-specific monitoring program was implemented at the 183-H Basins as part of the regulatory compliance effort being conducted on the Hanford Site. This monitoring program was based on the ground-water monitoring requirements for interimstatus facilities, which are those facilities that do not yet have final permits, but are authorized to continue interim operations while engaged in the permitting process. The program initially implemented for the 183-H Basins was designed to be an alternate program, which is required instead of the standard detection program when a facility is known or suspected to have contaminated the ground water in the uppermost aquifer. This effort, named the RCRA Compliance Ground-Water Monitoring Project for the 183-H Basins, was implemented. A supporting project involving ground-water flow modeling for the area surrounding the 183-H Basins was also initiated during 1985. Those efforts and the results obtained are described in subsequent chapters of this document. 26 refs., 55 figs., 14 tabs.

30089 **(PNL—6471) Interim characterization report for the area surrounding the 183-H Basins.** (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 441p. NTIS, PC A; 19; GPO Dep. Order Number DE88007417/JAW.

This document contains information on the results of recent characterization work in five areas: geology, hygrology, geochemistry, ground-water modeling, and ground-water monitoring. This characterization work has been conducted as part of the ground-water monitoring compliance program for a Hanfrod Site waste-storage facility known as the 183-H Solar Evaporation Basins (183-H Basins). The characterization work described here represents the latest part of an effort initiated in June 1985. The initial sampling effort mentioned above was expanded to onclude characterization studies and installation of new wells. The objectives were to collect additional site-specific hydrogeologic information needed to more fully characterize the area and support decisions concerning the monitoring network for the 183-H Basins, and to conduct an expanded sampling and analysis effort designed to determine both the extent of contamination originating from the basins and the rate of movement of contaminants. Sisteen new wells were installed. The initial evaluations based on data and other characterization work conducted simultaneously are presented in this document. A brief summary of key findings is presented, and furhter detail is contained in the remainder of this document. 36 refs., 101 figs., 18 tabs.

30090 **(PNL—6491-1) Northwest Hazardous Waste Research, Development, and Demonstration Center: Program Plan.** (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88007599/JAW.

The Northwest Hazardous Waste Research, Development, and Demonstration Center was created as part of an ongoing federal effort to provide technologies and methods that protect human health and welfare and environment from hazardous wastes. The Center was established by the Superfund Amendments and Reauthorization Act (SARA) to develop and adapt innovative technologies and methods for assessing the impacts of and remediating inactive hazardous and radioactive mixed-waste sites. The Superfund legislation authorized $10 million for Pacific Northwest Laboratory to establish and operate the Center over a 5-year period. Under this legislation, Congress authorized $10 million each to support research, development, and demonstration (RD and D) on hazardous and radioactive mixed-waste problems in Idaho, Montana, Oregon, and Washington, including the Hanford Site. In 1987, the Center initiated its RD and D activities and prepared this Program Plan that presents the framework within which the Center will carry out its mission. Section 1.0 describes the Center, its mission, objectives, organization, and relationship to other programs. Section 2.0 describes the Center's RD and D strategy and contains the RD and D objectives, priorities, and process to be used to select specific projects. Section 3.0 contains the Center's FY 1988 operating plan and describes the specific RD and D projects to be carried out and their budgets and schedules. 9 refs., 18 figs., 5 tabs.

30091 **(PNL—6493) Bird associations with shrubsteppe plant communities at the proposed reference repository location in southeastern Washington.** Schuler, C.A.; Rickard, W.H.; Sargeant, G.A. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 37p.

This report provides information on te seasonal use of shrubsteppe vegetation by bird species at the RRL. Bird abundance and distribution were studied at the RRL to ensure that the DOE monitored migratory bird species pursuant to the Migratory Bird Treaty Act and to assess potential impacts of site characterization activities on bird populations. Birds were counted on two transects that together sampled an areas of 1.39 km^2. The relative abundance of birds, species richness, seasonal distribution, and the association of breeding shrubsteppe birds with major vegetation types were determined from Janurary through December 1987. Only 38 species

were counted during 82 surveys. Total bird density during the nesting season (March-June) was 42.96 birdskm^2 and the density for the entire year was 26.74 birdskm^2. The characteristic nesting birds in shrubsteppe habitats were western meadowlark, sage sparrow, burrowing owl, mourning dove, horned lark, long-billed curlew, lark sparrow, and loggerhead shrike. Western meadowlark and sage sparrows were the most abundant breeding birds with an average density of 11.25 and 7.76 birdskm^2, respectively. Seasonal distribution of birds varied with species, but most species were present from March to September. Distribution and abunandance of nesting birds were correlated with habitat type. About 63% of the habitat surveyed was sagebrush, 26% was cheatgrass, and 11% was spiny hopsage. Sagebrush habitat supproted a greeater total bird density than cheatgrass or hopsage habitats. Sage sparrows were closely associated with sagebrush habitats, while western meadowlarks showed no strong habitat affinities. 22 refs., 9 figs., 6 tabs.

30092 **(PNL-SA—14711) Application of exemption principles to low-level waste disposal and recycle of wastes from nuclear facilities.** Kennedy, W.E. Jr.;Hemming, C.R.;O'Donnell, F.R.;Linsley, G.S. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 5p. (CONF-880404—16).

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

The International Atomic Energy Agency (IAEA) and other international groups are considering exempting from regulatory control certain radiation sources and practices, initially under the general heading of de minimis. A significant fraction of the wastes from industry, research, medicine, and the nuclear fuel cycle are contaminated to such low levels that the associated risks to health are trivial. IAEA work has been conducted by Advisory Groups to establish principles for exemption, and to apply the principles to various areas of waste management. In the second area, the main objectives have been to illustrate a methodology for developing practical radiological criteria through the application of the IAEA preliminary exemption principles, to establish generic criteria, and to determine the practicability of the preliminary exemption principles. The method used relies on a modeling assessment of the potential radiation exposure pathways and scenarios for individuals and population groups following the unrestricted release of materials. This paper describes the IAEA's assessment methodology and presents the generic results expressed in terms of the limiting activity concentration in municipal waste and in low-activity materials for recycle and reuse. 2 refs., 2 tabs.

30093 **(PNL-SA—15277) In situ vitrification: Preliminary results from the first large-scale radioactive test.** Buelt, J.L.; Westsik, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 25p. (CONF-880354—5).

From Waste management '88; Tucson, AZ, USA (1 Mar 1988).

The first large-scale radioactive test (LSRT) of In Situ Vitrification (ISV) has been completed. In Situ Vitrification is a process whereby joule heating immobilizes contaminated soil in place by converting it to a durable glass and crystalline waste form. The LSRT was conducted at an actual transuranic contaminated soil site on the Department of Energy's Hanford Site. The test had two objectives: (1) determine large-scale processing performance and (2) produce a waste form that can be fully evaluated as a potential technique for the final disposal of transuranic-contaminated soil sites at Hanford. This accomplishment has provided technical data to evaluate the ISV process for its potential in the final disposition of transuranic-contaminated soil sites at Hanford. Because of the test's successful completion, within a year technical data on the vitrified soil will be available to determine how well the process incorporates transuranics into the waste form and how well the form resists leaching of transuranics. Preliminary results available include retention of transuranics and other elements within the waste form during processing and the efficiency of the off-gas treatment system in removing contaminants from the gaseous effluents. 13 refs., 10 figs., 5 tabs.

30094 **(PNL/SRP-SA—15685) Evaluation of the corrosion behavior of nickel- and copper-base alloys in high-magnesium brine.** Westerman, R.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 12p. (CONF-880377—2).

From Joint U.S. DOE/FRG workshop on nuclear package materials; Albuquerque, NM, USA (9 Mar 1988).

The reference design of a package for containing high-level nuclear waste in a salt repository utilizes a mile steel container. An alternate material, selected from a group of six Ni- and Cu-base alloys, is being considered for this waste package application in the event that the mild steel proves inadequate as a corrosion barrier. The corrosion behavior of Ni-base alloys has been obtained, in the present study, by examining the behavior of seal-welded test vessels made of Ni-Cr-Mo alloys used to contain steel specimens in anoxic, two-phase salt/brine environments. In addition, an irradiation-corrosion scoping test of Ni-base alloy crevice corrosion specimens was performed. The only degradation noted of the Ni-base alloys occurred in the case of a leaky seal-welded vessel, in which air and brine simultaneously contacted the wall of the container, producing numerous small pits. Cu-base alloys were found to be highly corrosion resistant in anoxic brines. The potential effects of radiolysis products, air, or sulfides remains to be determined. 2 refs., 1 fig., 6 tabs.

30095 **(RFP—4214) Preparation of fluidized bed incinerator for hazardous and radioactive mixed waste trial burn.** Ziegler, D.L.; Johnson, A.J. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1988]. Contract AC04-76DP03533. 13p.

Following a seven year process development effort, a production scale Fluidized Bed Incinerator was constructed at the Rocky Flats Plant and an emission permit obtained. The incinerator was inactive for several years and is presently being upgraded and tested in preparation for a trial burn for combustion of liquid and solid hazardous radioactive mixed waste. A description of equipment modifications and instrumentation addition necessary for permitting as a mixed waste incinerator are discussed. The trial burn plan was submitted to the regulatory authorities and has been reviewed by the public. Questions, comments, and concerns generated by the regulatory authorities, a technical review panel, and the general public are discussed in this paper. 1 fig., 3 tabs.

30096 **(SAND—87-2256C) Numerical simulation of WIPP [Waste Isolation Pilot Plant] panel entryway seal/formation structural interaction.** Argueello, J.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880654—1).

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

A series of structural analyses were performed to evaluate the interaction of the components of a potential two-component panel entryway seal configuration with each other and with the rock salt formation at the repository horizon of the Waste Isolation Pilot Plant. A two-dimensional axisymmetric geomechanical model of the configuration was used to evaluate a 30.5 m long seal, consisting of concrete end caps and a crushed salt core. 13 refs., 7 figs.

30097 **(SAND—87-2654C) WIPP/SRL in situ testing program: MIIT [Materials Interface Interactions Tests] update 1988.** Wicks, G.G.; Molecke, M.A. (Savannah River Lab., Aiken, SC (USA); Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789;AC09-76SR00001. 14p. (CONF-880201—22; DP-MS—87-105). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006645/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The first series of in situ, high-level wasteform leaching tests to be conducted in the United States was started on July 22, 1986. This effort, the WIPP Materials Interface Interactions Tests (MITT), involves the underground tests emplacement of about 1900 (nonradioactive) waste form, metal container, and geologic samples in the bedded salt at the Waste Isolation Pilot Plant (WIPP) facility, near Carlsbad, New Mexico. Samples were supplied from seven countries and are being analyzed by laboratories and universitites in

the United States, Canada, France, Germany, Belgium, Japan, the United Kingdom, and Sweden. Posttest analyses of samples removed after 0.5 and 1 yrs of testing are in progress now. Preliminary results on wasteform leaching and metal sample corrosion are reviewed; most samples had very little degradation. The MIIT data complement other laboratory and international in situ efforts involving underground field testing of Savannah River Laboratory simulated nuclear waste glasses. 14 refs., 6 figs.

30098 **(SAND—87-3016C) Cross-hole measurements of velocity and attenuation to detect a disturbed zone in salt at the Waste Isolation Pilot Plant.** Holcomb, D.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880654—7). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88004459/JAW.

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

Cross-hole ultrasonic measurements were made at the Waste Isolation Pilot Plant (near Carlsbad, New Mexico) to delineate the disturbed zone around drifts and rooms. Using compressional mode waves it was found that there was a small decrease in velocity and a large increase in attenuation immediately after the test room was mined. Disturbances extended at lease 3 metres from a room with a width of 5.5 metres. The results are interpreted as resulting from the introduction of about 0.5% crack-like, pore space. 7 refs., 4 figs.

30099 **(SAND—87-7171) Optimization of mechanical/corrosion properties of TI-CODE 12 plate and sheet: Part 2, Thermomechanical processing effects.** Schultz, R.W.; Hall, J.A. (Titanium Metals Corp. of America, Henderson, NV. Henderson Technical Lab.). Jan 1988. Contract AC04-76DP00789. 114p. NTIS, PC A06/MF A01;1; GPO Dep. Order Number DE88007493/JAW.

In an effort to determine and subsequently optimize mechanical and corrosion properties of the TI-CODE 12 alloy for DHLW container application, a two-stage study was conducted. Stage I was directed toward evaluation of the effect of compositional variations, within ASTM specification limits, on specific mechanical and corrosion properties of TI-CODE 12. Compositional variables investigated were weight percent molybdenum, nickel, oxygen, and iron. Compositional ranges of TI-CODE 12 were identified which correspond to select combinations of desirable properties. Stage II program objectives include evaluation of five distinct thermomechanical processes with respect to TI-CODE 12 0.25 inch (6.35mm) plate and 0.070 inch (1.78mm) sheet corrosion and mechanical propreties, with subsequent selection of a process route which achieves optimum properties. In addition to addressing effects of intermediate recrystallization and cross-rolling steps for reduction of property directionality, the influence of final product anneal is examined. In particular, the influence of a conventional mill anneal at 1450°F (788°C) is compared to that of the sub-eutectoid 1250°F (677°C) annual which is known to facilitate precipitation of nickel-rich intermetallic compound in TI-CODE 12. sup (18,19,20). Specific alloy properties considered include tensile strength and ductility, bend ductility, slow strain rate fracture toughness, creep strength, and general and crevice corrosion resistance. 24 refs., 25 figs., 24 tabs.

30100 **(SAND—88-0001C) A conceptual design for a nuclear waste repository at the Yucca Mountain site.** Hunter, T.O.; Tillerson, J.R.; Stevens, A.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880601—5). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88004126/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The NNWSI Project of the U.S. Department of Enrgy has recently completed a conceptual design for a nuclear waste repository at the Yucca Mountain site. This conceptual design supports the site characterization program by defining a reference description of surface and underground facilities. This reference description would provide a basis for identifying design-related issues and determining the appropriate site characterization activities to obtain needed information about the site. 2 figs.

30101 **(SAND—88-0035C) Effect of material nonhomogeneities on equivalent conductivities in unsaturated porous media flow.** Eaton, R.R.; Dykhuizen, R.C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 16p. (CONF-880582—1).

From Validation of flow and transport models for the unsaturated zone meeting; Ruidoso, NM, USA (23 May 1988).

Deterministic calculations of the flow of water through partially saturated, geologic materials are complicated by the heterogeneous nature of the geologic media and the uncertainty of material properties. Consequently, there is a trend toward the development of stochastic solution procedures and equivalent material property concepts for use in predicting bounds on water motion and particle travel times. A numerical investigation of the effect of material heterogeneities on two-dimensional deterministic calculations of water flow and particle travel times is presented. Upper and lower bounds on the infiltration rates for Dirichlet boundary conditions are defined as a function of the degree of material heterogeneity. These calculations are an extension of earlier work in which parallel and series circuit concepts were used to define limiting flow conditions for flow in saturated media. Because of the nonlinear nature of flow in partially saturated media, the techniques applicable for determining the bounds for saturated flows do not apply. 4 refs., 8 figs., 2 tabs.

30102 **(SKB-SP-TR—87-01) Final report of the borehole, shaft and tunnel sealing test. Volume 1: Borehole plugging.** Pusch, R.; Boergesson, L.; Ramqvist, G. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jan 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753021/JAW.

The Borehole Plugging Experiment comprised field tests of the sealing function and the practicality in handling and application of plugs consisting of segments of perforated metal casings filled with cylindrical blocks of highly compacted sodium bentonite. Preparative tests had shown that the clay swells out through the perforation and embeds the casings. The field tests demonstrated that even very long holes can be effectively sealed by such plugs and that the clay becomes very homogeneous and forms a tight contact with the rock in a relatively short time. By that the plugs become practically impervious and the flow along the clay/rock contact will be insignificant. The longevity of such plugs extends over several thousand years under the conditions that usually prevail in crystalline rock. (authors).

30103 **(SKB-SP-TR—87-02) Final report of the borehole, shaft, and tunnel sealing test. Volume II: Shaft plugging.** Pusch, R.; Boergesson, L.; Ramqvist, G. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). Jan 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753022/JAW.

Shaft sealing by use of highly compacted bentonite was investigated in a 14 m long shaft in which two plugs were constructed with a central sand-filled central space for injecting water. A first reference test with concrete plugs was followed by a main test in which the plug material consisted of blocks of highly compacted sodium bentonite powder. In the latter test, the outflow from the injection chamber was only a few percent of that with the concrete plugs, which demonstrates the excellent sealing properties of the clay. The main effect was that practically no water flow took place along the rock/clay interface. The longevity of smectite clay in crystalline rock is sufficient to make bentonite plugs operative for several thousand years. (authors).

30104 **(SKB-SP-TR—87-04) Crosshole investigations - Details of the construction and operation of the hydraulic testing system.** Holmes, D.; Sehlstedt, M. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). May 1986. 71p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753023/JAW.

The Crosshole Programme, part of the international Stripa Project is designed to evaluate the effectiveness of various remote-sensing techniques in characterizing a rock mass around a repository. A multidisciplinary approach has been adopted in which various geophysical, mapping and hydrogeological methods are used to

determine the location and characteristics of significant features in the rock. The Programme utilises six boreholes drilled in a fan array from the 360 metre level in the Stripa Mine, Sweden. The hydrogeological component of the work uses single and crosshole testing methods, including sinusoidal pressure testing, to locate fractures and characterize groundwater movement within them. Crosshole methods use packers to isolate portions of two boreholes which both intersect a significant feature in the rock mass. Hydraulic signals are generated in one isolated section and received in the other borehole. This report describes the design and operation of the computer-controlled system which automatically performs the hydrogeological tests. (authors).

30105 **(SKN—17(v.1A)) Technical and socio-political issues in radioactive waste disposal 1986. Vol. 1A. Safety, siting and interim storage. Appendices: Countries and international organisations.** Parker, F.L.; Kasperson, R.E.; Andersson, T.L.; Parker, S.A. (Beijer Inst., Stockholm (Sweden)). (National Board for Spent Nuclear Fuel, Stockholm (Sweden); Beijer Inst., Stockholm (Sweden)). Nov 1987. 207p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753588/JAW.

Review of radioactive waste management activities and goals in the Federal Republic of Germany, France, Sweden, Switzerland, United Kingdom, USA, European Communities, IAEA, NEA, ICRP and UNSCEAR.

30106 **(SKN—17(v.2)) Technical and socio-political issues in radioactive waste disposal 1986. Vol. 2. Subseabed disposal.** Parker, F.L.; Kasperson, R.E.; Andersson, T.L.; Parker, S.A. (Beijer Inst., Stockholm (Sweden)). (National Board for Spent Nuclear Fuel, Stockholm (Sweden); Beijer Inst., Stockholm (Sweden)). Nov 1987. 91p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753589/JAW.

Subseabed disposal of high level radioactive waste and spent fuel, in contrast to land based mined geologic repositories, has not yet been judged by any nation or international bodies to be technologically acceptable, but it is presently considered to be the only available alternative to land based geologic disposal. The work under the scientific program for subseabed disposal the most truly international of all the radioactive waste program, was proceeding along a well defined route to proof or rejection of concept. This date will certainly be delayed because of the withdrawal of the USA from the program. The work under the aegis of the NEA will result in a report in 1987 that will be a status report. To date no scientific information has emerged that would negate the advantages of the subseabed disposal method. Validation of some of the models has not been completed. The option, if possible, would be very attractive for many reasons including no easy direct exposure to man, no contamination of potential drinking water supplies, no near neighbors, an international solution rather than a parochial solution, and location in a formation with highly desirable attributes (stability, exchange capacity, etc.) that may not be available in every nation with a nuclear energy program. Even if the scientific feasibility were proven, then there still remain enormous institutional obstacles to be overcome including the determined opposition of many countries on ecological and philosophical grounds, the existence of international treaties that appear to prohibit such disposal and the fact that it is not the first choice for disposal of spent nuclear fuel or high level radioactive waste.

30107 **(SKN—19) Risk decisions and nuclear waste.** Hansson, S.O. (National Board for Spent Nuclear Fuel, Stockholm (Sweden)). Nov 1987. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753590/JAW.

The risk concept is multidimensional, and much of its contents is lost in the conventional reduction to a unidimensional and quantifiable term. Eight major dimensions of the risk concept are discussed, among them the time factor and the lack-of-knowledge factor. The requirements of a rational discourse are discussed, in general and in relation to risk issues. It is concluded that no single method for the comparison and assessment of risks can be seen as the only rational method. Different methods can all be rational, although based on different values. Risk evaluations cannot be performed as expert assessments, divorced from the political decision process. Instead, risk evaluation must be seen as an essentially political process. Public participation is necessary in democratic decision-making on risks as well as on other issues. Important conclusions can be drawn for the management of nuclear waste, concerning specifications for the technical solution, the need for research on risk concepts, and the decision-making process.

30108 **(TE—014Q/86/W0003) Report on current research into organic materials in radioactive waste.** Norris, G.H. (Department of the Environment, London (UK); Taywood Engineering Ltd., Winfrith (UK)). Nov 1987. 25p. (DOE-RW—87.110). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752755/JAW.

A preliminary review of relevant recent papers on organic materials in radioactive waste is presented. In particular, the effects of chelating or complexing agents, the influence of bacteria and the role of colloids are assessed. The requirement for further radioactive waste inventory detail is indicated. Potential problem areas associated with the presence of organic materials in radioactive waste are identified and appropriate experimental work to assess their significance is proposed. Recommendations for specific further work are made. A list and diagrams of some of the more important polymer structures likely to be present in radioactive waste and their possible degradation products are appended.

30109 **(TE—014Q/87/W0006) Review of literature relevant to gas production in radioactive waste.** Norris, G.H. (Department of the Environment, London (UK); Taywood Engineering Ltd., Winfrith (UK)). Nov 1987. 62p. (DOE-RW—87.109). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752756/JAW.

A review of relevant recent papers on gas generation in low-level wastes and intermediate-level wastes is presented. Chemical, microbiological, radiolytic and thermal reactions are considered for both unconditioned wastes and wastes conditioned in cement, or bitumen, or polymer. Possible reaction mechanisms are identified and the effects of temperature and pressure are evaluated. Estimations of the production of combustible gases (which also have the potential to form explosive mixtures) have been taken from the literature. The implications of gas production for pressurisation (and possible rupture) of waste drums and of a repository are assessed. Waste-treatment schemes for the reduction of gas-generation capacity of several waste-types are highlighted. Recommendations for further work are summarised.

30110 **(TE—014Q/87/W0007) Initial appraisal of destructive testing of radioactive waste packages.** Green, T.H. (Department of the Environment, London (UK); Taywood Engineering Ltd., Winfrith (UK)). Nov 1987. 37p. (DOE-RW—87.111). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752757/JAW.

An initial appraisal of destructive testing techniques has been undertaken, as part of the Department of the Environment initiative to establish an independent Quality Checking Facility for LLW and ILW packages. The reasons for destructive testing are discussed, and examples of chemical separation and analyses techniques are given.

30111 **(TKK-DISS—642) Safety and performance assessment of geologic disposal systems for nuclear wastes.** Peltonen, E. (Helsinki Univ. of Technology, Otaniemi (Finland)). 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753030/JAW.

This thesis presents a methodology for the safety and performance assesment of final disposal of nuclear wastes into crystalline bedrock. The applicability of radiation protection objectives is discussed, as well as the goals of the assessment in the various repository system development phases. Due consideration is given to the description of the pertinent analysis methods and to the comprehensive model system. The methodology has been applied to assess the acceptability of the basic disposal concepts and to study the possibilities for the optimization of protection. Furthermore, performance of different components in the multiple barrier disposal systems is estimated. The waste types dealt with are low- and

intermediate-level waste as well as high-level spent nuclear fuel from a nuclear power plant. In addition, an option of high-level vitrified waste from reprocessing of spent fuel is taken into account. On the basis of the various analyses carried out it can be concluded that the disposal of different nuclear wastes in the Finnish bedrock in properly designed repositories meets the radiation protection objectives with good confidence. In addition, the studies indicate that the safety margins are considerable. This is due to the fact that the overall performance of the multiple barrier disposal systems analysed is not sensitive to possible unfavourable changes in barrier properties. From the optimization of protection point of view it can be concluded that there is no need to develop more effective repository designs than those analysed in this thesis. In fact, the results indicate that the most sophisticated designs have already gone beyond an optimal level of safety.

30112 **(UCID—21274) Plan for integrated testing for NNWSI [Nevada Nuclear Waste Storage Investigations] non EQ3/6 data base portion.** Oversby, V.M. (Lawrence Livermore National Lab., CA (USA)). 29 May 1987. Contract W-7405-ENG-48. 21p.

The purposes of the Integrated Testing Task are to develop laboratory data on thermodynamic properties for actinide and fission product elements for use in the EQ3/6 geochemical modelling code; to determine the transport properties of radionuclides in the near-field environment; and develop and validate a model to describe the rate of release of radionuclides from the near-field environment. Activities to achieve the firs item have been described in the Scientific Investigation Plan for EQ3/6, where quality assurance levels were assigned to the acitivities. This Scientific Investigation Plan describes activities to achieve the second and third purposes. The information gathered in these activities will be used to assess compliance with the performance objective for the Engineered Barrier System (EBS) to control the rate of release of radionuclides if the repository license application includes part of the host rock; to provide a source term for release of radionuclides from the waste package near-field environment to the system performance assessment task for use in showing compliance with the Environmental Protection Agency requirements; and to provide a source term for release of radionculides from the waste package near-field environment to the system performance assessment task for use in doing calculations of cumulative releases of radionuclides from the repository over 100,000 years as required by the site evaluation process. 5 refs.

30113 **(UNI-SA—204) Metal melting for volume reduction and recycle.** Miller, R.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 27 Mar 1987. Contract AC06-76RL01857. 12p. (CONF-8705262—1).

From Technical advisory group meeting; Karlsruhe, F.R. Germany (7 May 1987).

This paper summarizes the experiences with melting contaminated steel materials for volume reduction and melting uranium-contaminated copper and aluminum for possible recycle. In the past there has not been an economic incentive to reduce the volume of low-level beta-gamma contaminated metallic scrap materials in the United States. With the rising cost of transportation and burial facility fees new interest in volume reduction is being generated. This new interest has been primarily focused at the Idaho National Engineering Laboratory (INEL) where the Waste Experimental Reduction Facility (WERF) was established to demonstrate both metal melting and incineration of combustible material for volume reduction. Other demonstration programs involving melting for volume reduction and recycle of aluminum and copper, as well as ferrous scrap, were related to the Cascade Improvement and Cascade Upgrade Programs (CIP/CUP) at the Paducah, Kentucky facility. While the melting demonstrations for the CIP/CUP material were not primarily based on economic incentives, several observations recorded during the programs are of interest with regard to melting of copper and aluminum. (4 refs., 8 tabs.)

30114 **(USGS-OFR—87-408) Evaluation of the seismicity of the southern Great Basin and its relationship to the tectonic framework of the region.** Rogers, A.M.; Harmsen, S.C.; Meremonte, M.E. (Geological Survey, Denver, CO (USA)). 1987. Contract AI08-78ET44802. 196p.

Seismograph network recordings of local and regional earthquakes are being collected in the southern Great Basin to aid in the evaluation of the seismic hazard at a potential high-level radioactie waste repository site at Yucca Mountain in the southwestern Nevada Test Site. Data for 1522 earthquakes for the calendar years 1982 and 1983 are reported herein. In the period August, 1978 through December, 1983, 2800 earthquakes were located within and adjacent to the southern Great Basin seismograph network. Earthquake hypocenters, selected focal mechanisms, and other inferred seismicity characteristics are presented and discussed in relation to the local and regional geologic framework. 105 refs., 94 figs., 8 tabs.

30115 **Reaction of reference commercial nuclear waste glasses during gamma irradiation in a saturated tuff environment.** Bates, J.K.; Ebert, W.L.; Fischer, D.F.; Gerding, T.J. (Chemical Technology Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439-4837). *Journal of Materials Research;* **3**: No. 3, 576-597(May 1988). Contract W-31-109-ENG-38.

The effects of gamma irradiation on groundwater and the reaction between groundwater and glass have been investigated at radiation exposure rates of 2×10^5, 1×10^3, and 0 R/h. These experiments, which bound the conditions that may occur in a high-level nuclear waste repository located in tuff, have been performed using the actinide-containing glasses ATM-1c and ATM-8, and have been performed for time periods up to 278 days. The experimental results indicate that when only the repository groundwater is present, the pH of the system remains near-neutral, regardless of the radiation field, due to the buffering capacity of the solution. When glass is added to the system, the subsequent reaction is governed by the solution chemistry, which results from a complex interaction between radiolysis products, glass reaction products, and groundwater components. While no long-term reaction trends have been extracted from the current data, it is noted that there are no outstanding differences in the reaction of the glasses as measured by the release of the soluble components B, Mo, and Na, as a function of radiation exposure rate. However, there is a marked difference in the amount of U, Np, and Pu released from the glasses as a function of radiation exposure rate. This difference can be correlated with the pH values of the leachate, with more basic solutions resulting in lower actinide release.

30116 **From field data to fracture network modeling: an example incorporating spatial structure.** Long, J.C.S.; Billaux, D.M. (Lawrence Berkeley Lab., CA (USA)). *Water Resources Research;* **23**: No. 7, 1201-1216(Jul 1987). Contract AC03-76SF00098.

A technique for processing field data for a fracture network model which accounts for the observed spatial variability is described. This has been done by generating a network subregion by subregion where the properties of each subregion are predicted through geostatistics. Once the geometry of a particular realization is specified, flow through the network was studied. The method for a two-dimensional analysis based on data from Fanay-Augeres, a uranium mine in France was developed. It is planned to extend the analysis to three dimensions and compare the results with in situ test results. In particular, the focus was on the data collected in a long section of a drift where fractures have been mapped and steady state permeability tests have been performed in 10 boreholes.

30117 **Characterization of spent fuel disassembly hardware and nonfuel bearing components and their relationship to 10 CFR 61.** Luksic, A.T. (Pacific Northwest Lab., Richland, WA 99352 (US)). pp 475-482 of Waste management '87: Waste isolation in the US, technical programs and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—).

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

There are a variety of wastes that will be disposed of by the federal waste management system under the Nuclear Waste Policy Act of 1982. The primary waste form is spent nuclear fuel. Currently, this is in the form of fuel assemblies. If the fuel pins are removed from the fuel assembly, as in consolidation, then the fuel pins and the structural portion of the fuel assembly must be consid-

ered as separate waste streams. The structural hardware consists of end fittings, grid spacers, water rods (BWR 8 x 8 only), control rod guide tubes (PWR only) and various nuts, washers, springs, etc. These are referred to as spent fuel disassembly (SFD) hardware. There will also be a number of other components which are defined in Appendix E of 10 CFR 961, the standard utility contract. These are referred to as nonfuel-bearing (NFB) components, and include fuel channels (BWR), control rods, fission chambers, neutron sources, thimble plugs, and other components. This paper characterizes spent fuel disassembly (SFD) hardware, and nonfuel-bearing (NFB) components for the most abundant fuel types. The descriptions and figures given are representative for the items described. Many subvariants exist due to design evaluation, which are not covered. This paper also discusses the relationship of these wastes to 10 CFR 61 waste classification.

30118 **The integrated data base program: An executive-level data base of spent fuel and radioactive waste inventories, projections, and characteristics.** Klein, J.A. (Oak Ridge National Lab., Oak Ridge, TN 37831 (US)). pp 483-488 of Waste management '87: Waste isolation in the US, technical programs and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC05-84OR21400.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Integrated Data Base (IDB) is the official U.S. Department of Energy (DOE) data base for spent fuel and radioactive waste inventories and projections. As such, it should be as convenient to utilize as is practical. Examples of summary-level tables and figures are presented, as well as more-detailed graphics describing waste-form distribution by site and line charts illustrating historical and projected volume (or mass) changes. This information is readily accessible through the annual IDB publication. Other presentation formats are also available to the DOE community through a simple request to the IDB Program.

30119 **A typical, highly radioactive government-owned materials that may require geologic disposal.** Pearson, R.L.; Forsberg, C.W. (Oak Ridge National Lab., Oak Ridge, TN 37831 (US)). pp 489-494 of Waste management '87: Waste isolation in the US, technical programs and public education. Post, R.G. Tucson, AZ; University of Arizona Nuclear Engineering Dept. (1987). (CONF-870306—). Contract AC05-84OR21400.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

According to the Nuclear Waste Policy Act of 1982, the government must pay a waste fee for all government-owned "atypical" highly radioactive materials (AHRM). A search for such materials, utilizing the Nuclear Materials Management and Safeguards System data base, was completed. The results of this search provide a preliminary inventory and a description of the government-owned AHRM stored as of December 31, 1985, as well as an estimate of future accumulation.

30120 **Overview of treatment and conditioning of low-level wastes.** Trevorrow, L. (Argonne National Lab., IL (USA)). pp 1-9 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The consideration of alternative technologies in low-level waste management is assumed to be partly a response to current demands for lower risk in waste disposal. One of the determinants of risk in waste disposal is the set of characteristics of the materials placed into disposal cells, i.e., the products of treatment and conditioning operations. The treatment and conditioning operations that have been applied to waste streams are briefly examined. Three operations are the most important determinants of the stability that will contribute to reducing risk at the disposal cell: compaction, high-integrity containers, and solidification. The status of these three operations is reviewed. 22 references.

30121 **Overview of storage and disposal technologies.** Shaw, R.A. (Electric Power Research Institute, Palo Alto, CA (USA)). pp 11-18 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The selection of a waste disposal technology influences disposal costs directly through the disposal site charges and indirectly through the influences of the disposal site rules and the composition of the site charges. The composition of the site charges in turn influence the selection of volume reduction techniques for the processing of generated wastes. The manner in which waste generators can determine the costs associated with various waste processing techniques is illustrated. The waste disposal costs depend upon which particular waste disposal technology is selected. A generic description of waste disposal technologies is presented together with how these generic descriptions can be used to determine waste disposal site costs and performance. On-site short-term storage at the waste generator site is discussed particularly as related to reductions in waste disposal site volume allotments and to uncertainties in access to waste disposal sites.

30122 **Activities of the International Atomic Energy Agency.** Hirling, J. (International Atomic Energy Agency, Vienna (Austria)). pp 23-29 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The IAEA activities in radioactive waste management include the subject of handling, treatment, conditioning, storage and disposal of all categories of radioactive wastes as well as the sea disposal option, the environmental consequences of radionuclide releases, and decontamination and decommissioning of nuclear facilities. The task of the IAEA is to collect, review and disseminate information, to develop safety and regulatory guidelines, to encourage and sponsor research and provide technical assistance to its Member States. In this paper the IAEA work relevant to the safe and effective management of low- and intermediate-level waste is described.

30123 **OECD Nuclear Energy Agency's activities in relation to low-level radioactive waste management.** Bragg, K.; Olivier, J.P. (OECD Nuclear Energy Agency, Paris (France)). pp 31-36 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

This paper describes the general objectives of the Nuclear Energy Agency (NEA) of the Organization for Economic Co-operation and Development (OECD) as well as its role and activities in the field of Radioactive Waste Management. Its contribution to the discussion of radioactive waste management issues at international level is reviewed with particular reference to safety assessments for disposal options. In addition, emphasis is placed on the management of low and intermediate level waste and on their disposal on land at shallow depths. Criteria to limit the concentration of long-lived radionuclides are then discussed, specially in the context of human intrusion risks, after institutional control measures have ceased to apply.

30124 **Licensing of alternatives to shallow land burial: the NRC perspective.** Browning, R.E. (Nuclear Regulatory Commission, Chicago, IL (USA)). pp 39-42 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The ultimate goal of the NRC low-level waste program is the timely receipt of complete applications leading to the issuance

of licenses for the construction and operation of safe and environmentally sound disposal facilities. This paper describes the NRC's ongoing efforts to develop guidance on alternative disposal methods and their views on timely licensing of new disposal sites that may employ such methods. There are several approaches which are likely to expedite establishment of new disposal facilities, namely, standard designs, prequalification by regulatory agencies of certain systems and components, and early interaction between applicants and regulators through pre-licensing consultation. The five disposal alternatives that the NRC has studied are: shallow below-ground vaults, above-ground vaults, earth mounded concrete bunkers, mined cavity disposal, and augered hole or shaft disposal.

30125 **Alternatives to radioactive landfills: an environmental perspective.** Resnikoff, M. (Sierra Club Radioactive Waste Campaign, San Francisco, CA (USA)). pp 43-53 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

Environmental organizations strongly oppose conventional radioactive landfills, based on the poor performance record. As detailed in the paper, the author supports instead a range of alternatives which match the hazard of the respective low level waste streams. On economic and public health grounds, supercompaction and storage of dry active waste is preferred over incineration. The rationale for allowing long-lived wastes, class C and greater, to be buried in surface facilities needs to be re-examined by the NRC. The small volume of such wastes, which arise primarily from decommissioned reactors and fuel hardware, could be easily accommodated in a high level waste repository. 9 references.

30126 **Geological disposal of low- and intermediate-level radioactive waste.** Rometsch, R.; Issler, H. pp 59-77 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

In Switzerland the nuclear power plant operators and the government office dealing with radioisotope applications are responsible for the final disposal of radioactive wastes. The federal safety authorities define the protection objectives to be achieved by the planned geologic repositories. Repositories of differing protection grade are foreseen and the wastes are allocated to an appropriate disposal facility in accordance with their radio-nuclide content. One possible concept involves the combination of low- and intermediate-level waste in one repository, but the finally chosen concept will depend upon the characteristics of the specific site selected for the facility. Following a lengthy site selection procedure, three sites have been retained for more detailed characterization, one each in anhydrite, marl and alpine gneisses. A data set derived from the marl site has been used as a basis for a model repository project which was required by the Swiss safety authorities for showing feasibility and safety for LLW/ILW. A mined cavern system was chosen with horizontal access. The safety assessment of the multibarrier system gave satisfactory results.

30127 **Geologic disposal of LLW in Sweden.** Nilsson, L.B.; Hedman, T. (Swedish Nuclear Fuel and Waste Management Co., Stockholm). pp 79-91 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

In Sweden the primary responsibility for the total radioactive waste management program lies with the nuclear power utilities. Comprehensive R & D and site investigations have been performed since 1977. A transport system and a central AFR-facility are in operation. A final repository for low and medium level wastes, SFR, is under construction and planned for commissioning in early 1988. SFR is located in granitic bedrock under the sea outside the Forsmark nuclear power station. The wastes with the highest radioactivity are deposited in concrete silos in excavated caverns. The silos are surrounded by bentonite clay. Model calculations with input data from borehole investigations and laboratory experiments have shown that the release of radionuclides to the human environment will give a radiation level (dose), that at most will correspond to a few percent of the natural radiation. The total cost for SFR will affect the cost for the electric power with a few percent. A special information program is connected to the SFR project.

30128 **Geologic disposal of low-level radioactive waste in the Federal Republic of Germany.** Merz, E.R. (Nuclear Research Center (KFA), Juelich (West Germany)). pp 93-106 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The management of radioactive wastes has become a major concern, both for the public as well as those engaged in industry, particularly with regard to the release of radioactive material to the environment and possible risks of contamination. In the Federal Republic of Germany waste management is based on disposal of radioactive wastes in repositories accommodated in deep geological formations. These repositories may be newly mined facilities or abandoned mines with suitable geology and hydrology. In the repository the wastes are isolated from the biosphere by a system of multiple engineered and natural barriers. The raw wastes have to be transformed into a physically and chemically resistant form to produce waste packages which satisfy the requirements of safe transport, handling, interim storage and disposal. According to the 1976 amendment of the German Atomic Energy Act, the Physikalisch-Technische Bundesanstalt (PTB) is responsible for the disposal of radioactive wastes. Two sites are presently under consideration as repositories. In the former KONRAD iron ore mine it is intended to dispose of those low-level wastes which have a negligible thermal impact upon the host rock. The Gorleben salt dome is being investigated for its suitability to serve as a repository for all kinds of solid and solidified radioactive waste. Both projects are progressing according to schedule. The ASSE salt mine is being used for supplementary R & D investigations.

30129 **AECL's activities in the management of low-level radioactive wastes in Canada.** Charlesworth, D.H. (Atomic Energy of Canada Ltd., Chalk River, Ontario (Canada)). pp 115-126 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

Low-level radioactive waste-management operations at the Chalk River Nuclear Laboratories (CRNL) of Atomic Energy of Canada Limited (AECL) began in 1946 and currently include waste processing and interim storage in engineered facilities built in unsaturated sandy overburden. The wastes include low- and intermediate-level solid wastes generated on the CRNL site and shipped there from the nuclear industry, radioisotope producers and users across Canada. In addition, a development program has been underway for about ten years directed at preparations for a transition from the current storage mode to one of permanent disposal. The program is directed at improving waste characterization and processing, and at the development of disposal concepts potentially suitable for the local geological situation. The initial emphasis is on intrusion-resistant shallow land burial. Also of importance is the parallel development of safety-assessment methodologies. The overall objective is to construct and operate prototype facilities at CRNL as a component of an evolving integrated disposal strategy. 16 references.

30130 **Management of low and intermediate level nuclear wastes at Ontario Hydro.** Isaac, H.N.; Rao, P.K.M. (Ontario Hydro, Toronto (Canada)). pp 127-146 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

Ontario Hydro is a publicly-owned electric utility with 13,600 MW(e) of CANDU PHW nuclear generating capacity currently in service or under construction. The low and intermediate level wastes produced by this nuclear program are being stored in a centralized waste management facility at the Bruce Nuclear Power Development (BNPD) Site, which is owned and operated by Ontario Hydro. This paper describes the existing radioactive waste handling, processing, transportation and storage systems in operation at the nuclear stations and the centralized waste management facility. The paper also reviews the ongoing studies and engineering development being carried out by Ontario Hydro in conjunction with AECL on alternative methods for the permanent disposal of these radioactive waste materials.

30131 **Management system of low-level radioactive waste in Japan.** Sakata, S. (Radioactive Waste Management Center, Tokyo (Japan)). pp 147-171 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The basic scheme formulated by the government for the regulation of land disposal of low-level and short-lived solid radioactive waste is in preparation. A program is being developed in the Shimokita area by the private sector along with the scheme. The concept to be adopted is emplacement of waste packages in reinforced concrete pits installed underground. Further progress requires extensive efforts in research, development and demonstration tests, as well as collection and examination of information, schedule, and parameters in order to realize land disposal in the early 90's. 14 references.

30132 **Low and medium radioactive waste management in Belgium.** Dejonghe, P.; Bonne, A.; Van de Voorde, N.; Detilleux, E. (CEN/SCK, Mol (Belgium)). pp 177-195 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

This paper summarizes some information on the producers and production of radioactive wastes in Belgium, the evolution of the technical thinking in this area, how the management of radioactive wastes has been and is being organized in the country, and some practical achievements. This paper does not contain much information on new methods and processes and is based primarily on actual experience. Successively the following subjects are discussed: the waste producers; the main objectives in treatment/conditioning and disposal; organization; treatment and conditioning technology; and storage and disposal.

30133 **Management of low- and intermediate-level wastes in the UK.** Flowers, R.H. (United Kingdom Atomic Energy Authority, Harwell (England)). pp 197-209 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The organizations responsible for the regulation and implementation of low- and intermediate-level solid radioactive waste disposal in the UK are described. Waste classifications now in use are defined. The quantities of these wastes expected to arise over the next 25 years are estimated and plans for their disposal briefly outlined. The principles upon which the safety of a new trench site will be based are summarized and the current NIREX concepts for the repository are described.

30134 **Management of low-level radioactive waste in France.** Barthoux, A. pp 217-232 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The safe long-term management of low-level radioactive waste in France is a matter of national importance that gave rise to a body of regulations and to the creation of a public service agency called ANDRA with waste management oversight responsibility, and particularly for disposal. ANDRA has developed waste acceptance criteria based on safety regulations that stipulate adequate waste isolation through the use of physical barriers and a limited institutional control period through limitations in the quantities and half-lives of radionuclides that may be disposed. The current disposal situation at the Centre de la Manche is described, including the coordination of waste processing, shipping and disposal activities, and the program for development of new disposal capacity is outlined. Public information efforts relating to the new disposal facility are also addressed.

30135 **Implementing safety requirements for low-level radioactive waste management: the French system.** Hutchison, C. pp 233-238 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The organizations responsible for public health and safety in France have developed requirements relative to low-level radioactive waste management which stipulate, in particular, that there should be no spread of contamination under all foreseeable circumstances for the life of the disposal facility, and that there should be minimum impact on future generations as a result of disposal today. This translates into a maximum of physical barriers between the water and the environment in order to prevent any spread of contamination, and institutional control of the disposal facility for a reasonable period of time in order to ensure that the facility is properly maintained and kept from other uses after it has been closed. One of ANDRA's chief goals then, as the national waste management agency, is to implement these safety requirements in a manner that protects the public while taking into consideration the need for timely, cost-effective disposal services for radioactive waste generated by hospitals, research institutions, pharmaceutical laboratories and nuclear power plants. To this end, an integrated waste management system and a disposal facility concept called the earth-mounded concrete bunker were developed. The integrated waste management system, as its name implies, is a system that governs all aspects of the waste issue: it establishes rules for acceptable waste types and forms, schedules and tracks waste shipments, and monitors disposal operations. The earth-mounded concrete bunker is a disposal technology that features three different types of disposal structures corresponding to three broad categories of waste, along with several engineered systems to prevent any release of radioactivity to the environment. This paper addresses these two developments by illustrating how radioactive waste is safely managed from the point of generation to this final disposal.

30136 **Evaluation of a unique system for the thermal processing of radioactive and mixed wastes.** Armstrong, K.M.; Klingler, L.M. (Monsanto Research Corporation-Mound, Miamisburg, OH (USA)). pp 253-263 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

In 1981 Mound began a study to determine the feasibility of using an electrically heated glass furnace for the treatment of low-level radioactive wastes generated at commercial nuclear power facilities. This study featured experiments which were designed to address critical needs of the industry in the area of thermal waste processing, namely high quality combustion of organic constituents, radioactivity capture and immobilization, integrity of the final waste form, and cost effectiveness. In dealing with these concerns a variety of wastes typical of the types generated by nuclear power facilities, including not only standard trash but also wastes of high aqueous and/or inorganic content, were spiked with predominant waste radioisotopes and processed in the glass furnace. The results of this study indicate that the unit's capabilities fully meet the addressed needs of the nuclear industry for power plant waste proc-

essing. The quality of combustion observed during the initial studies on the glass furnace was such that a more demanding application was suggested - that of hazardous waste combustion. To evaluate the furnace's capabilities in this area a study was initiated in December, 1984 which simulated a trial burn of the type required for an EPA Part B permit for thermal processing of RCRA hazardous wastes. Solvents and sludges containing high percentages of water were spiked with problem toxic metals and cocktails of organics determined to be difficult to incinerate by the EPA. A complete sampling program following EPA protocol demonstrated destruction and removal efficiencies exceeding RCTA standards.

30137 **Role of recycling in the management of low-level radioactive wastes.** Dudey, N.D.; McGough, M.S. (Quadrex Corp., Oak Ridge, TN (USA)). pp 265-270 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The purpose of this discussion is to consider options now available to reduce the volume of low-level radioactive waste (LLW) requiring disposal and to examine the role of these options in the management of LLW, including their impact upon future disposal sites. Volume reduction refers to any process which is capable of reducing the physical volume of LLW that must be permanently disposed. This can be achieved by two generalized approaches: Processing and Physical Volume Reduction. Processing serves to separate the radioactivity from its underlying substrate, thereby concentrating the waste into a smaller volume. Physical volume reduction utilizes compaction, incineration, or repackaging to accommodate the same material within a smaller volume. The following discussion is directed primarily to processing of LLW and what is commercially available today.

30138 **Modular radwaste volume reduction and solidification systems.** Miller, E.L. (General Electric Co., San Jose, CA (USA)). pp 271-281 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

This paper describes both the modular transportable and the modular mobile liquid radwaste volume reduction and solidification units based on a General Electric Company developed and patented process called AZTECH (a trademark of GE). An AZTECH system removes all water by azeotropic distillation and encapsulates the remaining solids in a polyester compound. The resulting monolith is suitable for either long term above ground storage or shallow land burial. Pilot and demonstration plant testing has confirmed the design parameters. The three processing modules are covered together with data which resulted in Nuclear Regulatory Commission approval on Dec. 30, 1985.

30139 **Practical approach to LLRW volume reduction.** Skvara, D. pp 289-291 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

Scientific Ecology Group (SEG) has established a Central Volume Reduction Facility (CVRF) in Oak Ridge, Tennessee. The CVRF technology is used in France, Germany, and Holland for volume reduction of low-level radioactive wastes. The process can sort, section, decontaminate, supercompact, solidify liquid wastes, and incinerate radioactive wastes. The compacted density is over 85 pounds per cubic foot. The steps of the process are summarized in this paper.

30140 **Flexible OSSC or the on-site storage alternative and how it grew.** Dufrane, K.H. (Atcor Engineered Systems, Inc., Avon, CT (USA)). pp 293-310 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The On-Site Storage Container (OSSC) is an accepted and proven concept currently in widespread use for both operations and the storage of low level radioactive waste. In addition, it represents a very attractive enhancement to a geological low-level waste disposal site. Use of the proven OSSC concept at a site can provide additional safety to the environment by combining the benefits of an engineered storage facility with the proven safety of a sound geological repository. The concept of flexibility which was built into the OSSC concept for the temporary above ground storage of low-level waste is directly applicable to a permanent storage facility. Manufacturing costs, size flexibility, handling systems, and real-world operational advantages are well known and proven. This background provides a high confidence level for adapting this technology to a disposal site while keeping in mind the significance of both operational economics, safety to the environment, and ALARA principles. The development, design and cost effectiveness features of the OSSC as a temporary storage facility are discussed in detail. The flexible OSSC provides significant economic advantages over a permanent storage building. The application of the OSSC to a permanent geological disposal site provides the environmental advantages of an engineered facility while maintaining the inherent operational and economic benefits of the flexible OSSC concept.

30141 **Solidification of oil at the James A. Fitzpatrick nuclear power station.** Jones, D.; Remark, J.; D'Muhala, T.F.; Ward, R.C. (NUS Process Service Corp., Washington, DC (USA)). pp 311-315 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

During the operation of nuclear power plants, lubricating oils and greases can become contaminated by various mechanisms. To date, available methods for processing, packaging and disposal of these wastes have been found lacking due to increasing industry waste disposal regulatory constraints. So most utilities store these wastes on site for lack of a technically and economically viable method of disposal. Nuclear Technology Corporation (NUTEK), Amston, CT, has developed a simple, reliable, chemical process using ordinary portland cement to accomplish solidification of these contaminated lubricants. Resultant waste forms were evaluated against stability requirements. Tests were also conducted to ensure compliance with specifications for waste forms and to meet the guidelines on licensing requirements for land disposal of radioactive wastes. In November, 1985, NUTEK's 380A Oil Solidification Process was employed by NUS Process Services Corporation (NUSPSC) at New York Power Authority's James A. FitzPatrick Nuclear Power Station to process 2650 gallons of contaminated oil. The oil was successfully solidified in NUS-107 liners. This paper describes the process and characteristics of the resulting waste form.

30142 **Integrated system for the processing, storage, and disposal of low-level radioactive waste.** Mallory, C.W. (Westinghouse Hittman Nuclear Inc., Columbia, MD (USA)). pp 323-339 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The SUREPAK was originally developed as a system for the safe disposal of low-level radioactive waste. SUREPAK is an acronym for Subsurface Recoverable Packaging System. The SUREPAK system uses hexagonal reinforced concrete containers called SUREPAK modules to package waste in a stable form. The hexagonal SUREPAK modules are placed in a disposal trench in a close packed array to provide a structurally stable base to support a protective cover. This avoids subsidence and the other problems experienced with shallow land burial facilities. The SUREPAK concept has now been expanded to processing, storage and transport of low-level radioactive waste. The SUREPAK modules are designed

to receive waste packaged in drums, liners and higher integrity containers. The SUREPAK modules can also be used to receive and process the waste directly. The processed waste can be stored on-site pending the availability of permanent disposal space. This eliminates the need for expensive on-site disposal facilities. The SUREPAK modules are transported to the permanent disposal site when space becomes available. Transport of the SUREPAK modules is accomplished by the use of reusable impact skirts. The SUREPAK modules are then buried along with the SUREPAK modules packaged at the disposal site. The application of the SUREPAK system is presently constrained by a number of factors. The present regulations do not provide incentives for the use of high integrity, structurally stable containers. In fact, current price schedules discourage the use of such containers. Regulations and price schedules must be revised to foster use of improved disposal technology.

30143 Alternative low-level radioactive waste disposal system. Wright, S.V. pp 341-347 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The alternative disposal system concept suggested by the author is called ARDF, above ground retrievable disposal facility and can be adapted to any humid region. The system consists of a cellular reinforced concrete structure with surface layers of compacted low permeability concrete. The advantages are discussed and the design is detailed. Three volume reduction systems are recommended for collating with the ARDF: supercompactor, pathological and scintillation fluid incinerator, and decontamination.

30144 State-of-the-art technology as an alternative to the shallow land burial of LLRW. Price, W.E.; Galloway, L.A. III; Coley, R.F. (Nuclear Monitoring Systems & Management Corp., Houston, TX (USA)). pp 349-355 of Proceedings from the international symposium on alternative low-level waste technologies. Springfield, IL; Illinois Department of Nuclear Safety (1986). (CONF-860223—).

From Conference on all aspects of low level waste; Chicago, IL, USA (28 Feb 1986).

The authors present their position concerning key attributes of future low-level radioactive waste disposal facilities. First, in contrast to existing facilities which detect leakage of radioactive materials from waste packages after contamination of the environment, the authors believe that future facilities should be designed with the capability to both detect leakage and take corrective action without reliance upon the presence of radioactive materials within components of the environment. Second, in contrast to the present position of the US Nuclear Regulatory Commission, the authors believe that future disposal facilities should provide the local population with the capability for continuous monitoring for as long as desired. Third, in contrast to after-the-fact informing of the public, the authors believe that the public should be directly involved in the selection of the technology to be employed at future LLRW disposal facilities. They further believe that the process of technology selection should be finalized prior to site selection. Fourth, in contrast to common opinions, the authors show that an enhanced disposal alternative which also employs the continuous, advance-warning S/M/R (store/monitor/retrieve) disposal unit technology can be placed in service at reasonable cost schedules with lower escalation rates than the historical escalation of costs for shallow-land burial facilities. 15 references.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 30016, 30017, 30018, 30020, 30023, 30026, 30028, 30029, 30031, 30033, 30034, 30035, 30038, 30039, 30040, 30041, 30042, 30043, 30049, 30050, 30051, 30052, 30053, 30054, 30055, 30060, 30061, 30062, 30073, 30074, 30075, 30076, 30077, 30079, 30083, 30084, 30085, 30086, 30087, 30088, 30089, 30090, 30092, 30093, 30095, 30096, 30097, 30098, 30100, 30101, 30112, 30114, 30410, 30839, 31090

30145 (BNL-NUREG—40881) Prediction of the migration of radionuclides to the boundary of a shallow land burial trench. Sullivan, T.M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 14p. (CONF-880201—29).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

A general model which predicts the source term, radionuclide release rate, as a function of water flow, container degradation rate, waste form leach rate, and radionuclide migration rate from a low-level waste shallow land burial treach is being developed. This paper discusses modeling radionuclide migration, one component of the source term. Simulations of radionuclide transport from a generic shallow land burial trench have been performed for a range of water flow rates, dispersivity values, and distribution coefficients. For the modeling assumptions used and the range of parameters tested, the water flow rate plays the major role in redistributing radionuclides within the trench, except in the case of extremely high dispersion. Dispersion was always found to play significant role in determining transport. This was particularly apparent upstream from the source. Sorption decreased the magnitude of the radionuclide concentration and had the apparent effect of reducing the velocity with which the radionuclides were transported. Diffusion was found to be unimportant in determining radionuclide transport. 12 refs., 8 figs., 2 tabs.

30146 (PNL—6466) Ground-water monitoring compliance projects for Hanford Site facilities: Progress report for the period May 1 to September 30, 1986. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1986. Contract AC06-76RL01830. 317p.

This report documents recent progress on ground-water monitoring programs for four Hanford Site facilities: the 300 Area Process Trenches, the 183-H Solar Evaporation Basins, the 200 Area Low-Level Burial Grounds, and the Nonradioactive Dangerous Waste (NRDW) Landfill. This report is the first in a series of periodic progress reports, and it covers the time period from May 1 through September 30,1986. The existing ground-water monitoring programs for the first two facilities named above are currently being expanded by adding new wells to the networks. During the reporting period, sampling of the existing wells continued on a monthly basis, and the analytical results for samples collected from June through August 1986 are included and discussed in this document. 5 refs., 31 figs., 7 tabs.

30147 (RFP—4161) Simulated seismic event release fraction data: Progress report, April 1986-April 1987. Langer, G.;Deitesfeld, C.A. (ed.). (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 15 Nov 1987. Contract AC04-76DP03533. 13p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006978/JAW.

The object of this project is to obtain experimental data on the release of airborne particles during seismic events involving plutonium handling facilities. In particular, cans containing plutonium oxide powder may be involved and some of the powder may become airborne. No release fraction data for such scenarios are available and risk assessment calculations for such events lacked specificity describing the physical processes involved. This study has provided initial data based on wind tunnel tests simulating the impact of the debris on simulated cans of plutonium oxide powder. The release fractions are orders of magnitude smaller than previously available estimates. 8 refs., 3 figs., 2 tabs.

30148 **(PNL—6467-Vol.3-App.C-I) Ground-water monitoring compliance projects for Hanford Site facilities:.** (Pacific Northwest Lab., Richland, WA (USA); Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-76RL01830. 225p.

Appendix C contain the raw analytical data collected from the ground-water monitoring netoworks for the 183-H Solar Evaporation Basins for December 1986 through February 1987. Appendix D contains information on particle size analysis, calcium cabonate determinations, soil moisture analysis, and low-permeability unit analysis for samples from monitoring wells in the area of the NRDW Landfill. Appendix E contains lithologic logs and well construction summaries for wells in the area of the NRDW Landill. Appendix F contains geophysical logs for the wells in the area of the NRDW Landfill. The logs, gamma, neutron, and density, are all three plotted on graphs, one graph for each well. Appendix G provides aquifer test data, including pumping and observation well completions and locations, pumping rates, drawdown and recovery water-level data, and presentation and discussion of analyses. Appendix H provides water-level data collected at the Nonradioactive Dangerous Waste Landfill intended to provide information on the hydraulic gradients (horizontal and vertical) beneath the site. Appendix I contains measurements and samples taken from the pumping well discharge during aquifer tests, and from routine quarterly sampels taken during the first two quarters of monitoring.

30149 **(PNL—6465-Vol.3-App.C-G) Ground-water monitoring compliance projects for Hanford Site Facilities: Volume 3, Appendices C-G, Progress report for the period October 1 to December 31, 1986.** (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 300p. NTIS, PC A13; 3; GPO Dep. Order Number DE88007401/JAW.

This volume contains Appendicies C through G. Appendix C contains the geophysical logs for 12 new wells in the 100-H Area. Appendix D contains the Statement of Work which details the efforts needed to finish construction of the deep monitoring and observation wells at the Nonradioactive Dangerous Waste Landfill. Appendix E contains drilling logs, geologists' logs, and construction diagrams for the deep monitoring and observation wells at the Nonradioactive Dangerous Waste Landfill. Appendix F contains information on the hydrogeologic testing plan for new wells at the Nonradioactive Dangerous Waste Landfill. Included are the text of a presentation concerning this plan and an account of the discussion that followed. Appendix G contains raw analytical data from a set of samples collected in October 1986 from wells SM-1 through SM-5 at the Nonradioactive Dangerous Waste Landfill.

0540 Health And Safety

REFER ALSO TO CITATION(S) 29996, 29998, 31090, 31342

30150 **(CONF-880568—1) The ultrasonic ranging and data system for radiological surveys in the UMTRA [Uranium Mill Tailings Remedial Action] Project.** Little, C.A.;Berven, B.A.;Blair, M.S.;Dickerson, K.S.;Pickering, D.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p.

From Symposium on nuclear facility decommissioning: environmental effects of decommissioning nuclear facilities; Nashville, TN, USA (9 May 1988).

The Ultrasonic Ranging and Data System (USRADS) was developed to allow radiation exposure data and positional information to be collected, stored and analyzed in a more efficient manner than currently employed on the (Uranium Mill Tailings Remedial Action (UMTRA) project. USRADS is a portable unit which employs ultrasonics, radio frequency transmissions, and a personal computer. Operational experience indicates that the system results in increased information about the property with decreased data analysis and transcription effort and only slightly more field effort. 5 refs., 3 figs., 2 tabs.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 30370, 30968, 30993

30151 **(INIS-BR—1051) IAEA safeguard system.** Pontes, B.C. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1987. 21p. (In Portuguese). (CONF-8709269—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702315/JAW.

From Seminar Brazil and the international nuclear policy; Vienna, Austria (16 Sep 1987).

The intents of IAEA safeguards, analysing into the IAEA statutes, are presented. The different types of safeguard agreements; the measurements of accounting, containment and caution used by the operator and; the information to be provided and the verification to be developed by IAEA are described. (M.C.K.).

30152 **(Juel-Spez—417) Game theoretical analysis of safeguards effectiveness. Pt. 1. Attribute sampling.** Avenhaus, R.; Canty, M.J. (Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.)). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Technik und Gesellschaft; Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.)). Sep 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753576/JAW.

General non-sequential inspection situations are described in terms of abstract 'diversion paths' and associated a priori non-detection probabilities. A randomization of inspection activities is assumed in which in general only a subset of the paths are inspected. The problem of calculating a guaranteed detection probability for diversion along an arbitrary path is considered for different resource constraint assumptions. Rigorous and intuitively appealing solutions are presented.

30153 **(LA-UR—88-424) Holdup-related issues in safeguarding of nuclear materials.** Pillay, K.K.S. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 11p. (CONF-880352—2). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006469/JAW.

From INMM workshop on process holdup; Rockville, MD, USA (2 Mar 1988).

Residual inventories of special nuclear materials (SNM) remaining in processing facilities (holdup) are recognized as an insidious problem for both safety and safeguards. This paper identifies some of the issues that are of concern to the safeguards community at-large that are related to holdup of SNM in large-scale process equipment. These issues range from basic technologies of SNM production to changing regulatory requirements to meet the needs of safeguarding nuclear materials. Although there are no magic formulas to resolve these issues, there are several initiatives that could be taken in areas of facility design, plant operation, personnel training, SNM monitoring, and regulatory guidelines to minimize the problems of holdup and thereby improve both safety and safeguards at nuclear material processing plants. 8 refs.

30154 **(NUREG—0430-Vol.8-No.1) Licensed fuel facility status report: Inventory difference data, January 1987-June 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Mar 1988. 12p.

NRC is committed to the periodic publication of licensed fuel facilities' inventory difference data, following agency review of the information and completion of any related investigations. Information in this report includes inventory difference data for active fuel fabrication facilities possessing more than one effective kilogram of high enriched uranium, low enriched uranium, plutonium, or uranium-233.

30155 **(NUREG—1178) Vital equipment/area guidelines study: Vital area committee report: Final report.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Feb 1988. 95p.

A study was conducted by the staff to (1) re-evaluate the guidelines and bases used to determine what are the vital equipment

and areas to be protected against radiological sabotage in nuclear power plants and (2) to recommend revised guidance. On the basis of this study, the staff has recommended a revised vital equipment/area protection philosophy: to protect as vital the reactor coolant pressure boundary and one train of equipment that would provide the capability to achieve and maintain hot shutdown. To implement this overall protection philosophy, the saff also has recommended new analysis assumptions or guidelines to identify the specific equipment and areas in each plant that require protection as "vital".

30156 **(RFP—4092) Sources of measurement error in plutonium solids isotopic assay measurements.** Fleissner, J.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 40p. (CONF-8711108—2; CONF-870397—1).

From American Nuclear Society topical conference; San Diego, CA, USA (29 Nov 1987).

This paper discusses the sources of measurement error in plutonium solids isotopic assay measurements and also techniques to eliminate or reduce these sources of error through an understanding of the underlying physical principles of the isotopic measurement.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 30032, 30036, 30119, 30300

30157 **(INIS-BR—1002) Brazilian Nuclear Energy Commission and the health.** (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1987. 13p. (In Portuguese). (CONF-8709273—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702586/JAW.

From 1. meeting on nuclear energy uses in medicine; Rio de Janeiro, Brazil (1 Sep 1987).

The Program of Health Section / Brazilian Cnen, which was elaborated to promote the use of ionizing radiations (nuclear and x-ray techniques) in benefit of Brazilian health, with safety assurance of patients, personnels, population and environment, is presented. The Ministry of Health, industries, Medical and Physicist Associations, Universities and Research Centers are participants of this program. The activities involved in the program are: production of isotopes and radiopharmaceuticals; radiation detectors and nuclear instrumentation; radiation protection and dosimetry; education and training of human resources; applied research and new technologies. The guiding and actions that the section will adopt to attend the growing necessities of Brazilian society, considering technological powers, management, available substructure and associated difficulties are defined. (M.C.K.).

30158 **(NUREG—1310) Naturally occurring and accelerator-produced radioactive materials: 1987 review.** Austin, J.H. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). Mar 1988. 53p.

From time to time, the issue as to whether the US Nuclear Regulatory Commission (NRC) should seek legislative authority to regulate naturally occurring and accelerator-produced radioactive materials (NARM) is raised. Because NARM exists in the environment, in homes, in workplaces, in medical institutions, and in consumer products, the issue of Federal controls over NARM is very old and very complex. This report presents a review of NARM sources and uses as well as incidents and problems associated with those materials. A review of previous congressional and Federal agency actions on radiation protection matters, in general, and on NARM, in particular, is provided to develop an understanding of existing Federal regulatory activity in ionizing radiation and in control of NARM. In addition, State controls over NARM are reviewed. Eight questions are examined in terms of whether the NRC should seek legislative authority to regulate NARM. The assessment of these questions serves as the basis for developing and evaluating five options. The evaluation of those options leads to two recommendations.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 30765

30159 **(BNL—40968) Cu-64 production with BNL's high flux beam reactor.** Weber, M.; Lynn, K.G.; Roellig, L.O.; Moodenbaugh, A.R. (City Coll., New York (USA); Brookhaven National Lab., Upton, NY (USA)). 1985. Contract AC02-76CH00016. 4p. (CONF-8501118—2).

From Intense positron beams by world scientific press; Singapore, Singapore (6 Jan 1985).

This paper describes the work at the Brookhaven National Laboratory to utilize its High Flux Beam Reactor (HFBR) to produce ^{64}Cu which has a half-life of 12.8 hours and emits positrons 19% of the time. 2 figs.

0703 Isotopic Power Supplies

30160 **(LA—11166-MS) Light Weight Radioisotopic Heater Unit (LWRHU) production for the Galileo Mission.** Rinehart, G.H. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 43p.

The Light Weight Radioisotopic Heater Unit (LWRHU) is a ^{238}PuO/sub 2{minus/ fueled heat source designed to provide a thermal watt of power for space missions. The LWRHU will be used to maintain the temperature of various components on the spcaecraft at the required level. The heat source consists of a $^{238}PuO_2$ fuel pellet, a Pt-30Rh capsule, a pyrolytic graphite insulator, and a woven graphite aeroshell assembly. Los Alamos National Laboratory (LANL) has fabricated 134 heater units which will be used on the Galileo Mission. This report summarizes the specifications, fabrication processes, and production data for the heat sources fabricated at LANL. 4 figs., 15 tabs.

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 30760

30161 **(BNL—40235) Chemical/hydrogen energy systems: Annual report, January 1, 1986-December 31, 1986.** (Brookhaven National Lab., Upton, NY (USA)). Jun 1987. Contract AC02-76CH00016. 208p.

This report describes activities conducted during 1986 within the Chemical/Hydrogen Energy Systems (C/HES) Program, for which Bookhaven National Laboratory provides technical and management support to the U.S. Department of Energy. Research and exploratory efforts under this program have been directed towards developing a base technology that will apply to hydrogen production, storage, and transport. Major areas of interest include: (1) High Temperature Water Vapor Electrolysis for Hydrogen Generation (Westinghouse); (2) Evaluation of Materials for Medium Temperature Water Vapor Electrolysis; (3) Cryoadsorption of Hydrogen on Activated Carbon (Syracuse). Contributions in 1986 made by private sector contractors, university, researchers, and BNL in-house technical staff are summarized in the report. Also included is a summary of related International Energy Agency (IEA) cooperative efforts as well as plans and major activities scheduled for 1987.

0802 Storage

REFER ALSO TO CITATION(S) 30161

0803 Transport

REFER ALSO TO CITATION(S) 30161

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 29846, 30757

30162 **(ANL/CNSV-TM—194) An identification of potential binding agents for densified fuel preparation from municipal solid waste: Phase 1, Final report.** Daugherty, K.E. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 108p.

The literature search/laboratory test phase of this study examined over 100 potential d-RDF binders. This group has now been reduced to six candidates, which we believe to have the highest probability of commercial success. Section 2 of this report identifies various types of binding agents and possible processes in the densification investigation. Section 3 discusses thè development of binder/RDF procedurs for both the preliminary study and the laboratory study in the project; also included in this section are the protocols used to evaluate the binders. The fourth section provides flow diagrams for the preliminary study, the laboratory study, and the laboratory study modules. The fifth section reports the results from the worksheets on the binder/pellet/RDF evaluations and gives the final overall ratings; this section includes tables listing all of the binders evaluated in the laboratory study. The sixth section discusses the rankings in terms of the preliminary study, the laboratory study, and the overall ranking. Finally, the last two sections list the top six binders that will be evaluated in the pilot-plant test phase of the binder evaluation study and discuss plans for this next phase of the study. 6 figs., 3 tabs.

30163 **(ANL/CNSV-TM—196) High solids digestion of municipal solid waste to methane by anaerobic digestion.** Magruder, G.C.; Corder, R.E.; Clausen, E.C.; Gaddy, J.L. (Arkansas Univ., Fayetteville (USA)). Jan 1988. Contract W-31109-ENG-38. 86p.

One relatively simple energy alternative is the production of methane gas by anaerobic digestion. The process has received attention as a method of producing energy in the form of gaseous fuel renewable from lignocellulosic wastes. The US generates approximately 90 million tons of municipal solid waste (MSW) each year. This quantity could generate 900 billion cubic feet of methane per year, or nearly 5% of our natural gas requirements. The conversion of MSW to methane would not only help to alleviate our fuel shortage, but would also significantly reduce the problems of MSW disposal. One of the major problems associated with anaerobic digestion is the high capital costs required for large-scale reactors. Research should be undertaken to decrease reactor volume, thereby decreasing capital and operating costs. The traditional stirred-tank reactor offers the best possibility for successful application to large-scale MSW digestion. The CSTR is utilized in this study.

30164 **(ANL/CNSV-TM—197) Factors affecting acetate degradation in anaerobic digesters.** Mah, R.A.; Boone, D.R. (California Univ., Los Angeles (USA)). Jan 1988. Contract W-31109-ENG-38. 25p.

Acetate is the major source of methane produced in anaerobic digestion, accounting for about two thirds of all the methane produced. The major methanogenic bacteria responsible for this reaction are {ital Methanosarcina barkeri} and {ital Methanosarcina mazei}. One strain of each of these bacteria was selected for this study, in which the effect of molecular hydrogen on acetate dissimilation was examined. We examined the effects that hydrogen concentration had on the active growth of aceticlastic (acetate-splitting) cultures. We found that, during steady-state growth, each of these methanogens ({ital M. barkeri} or {ital M. mazei}) could tolerate a wide range of hydrogen concentrations with little change in their rates of acetate degradation. At hydrogen partial pressures as low as 2 Pa and as high as 800 Pa no change was detected in the growth rate or acetate degradation rate of either of these methanogens. However, we also showed that small amounts of hydrogen were produced or consumed by {ital Methanosarcina} in order to bring the hydrogen concentration in their environment to a pressure of 16 to 92 Pa, similar to that found in anaerobic digestors.

30165 **(ANL/CNSV-TM—198) Development of improved microbial strains for anaerobic digestion of municipal solid waste: Effects of trace metals on methanogenesis and control of sulfate reducing bacteria.** McKinney, R.E.; Lane, D.D.; Reifschneider, C.; Sandino, J.; Wallace, T.; Babu, R.; Baxter, T.; Tao, S.; Nafar, R.; Yang, Q. (Kansas Univ., Lawrence (USA)). Jan 1988. Contract W-31109-ENG-38. 82p.

This research project was designed to examine the effect of trace metals and the control of sulfate reducing bacteria on the development of improved microbial strains to treat municipal solid wastes as well as industrial wastes. The objective was to examine which trace metals were important and at what concentrations. It was hoped to develop control techniques to limit the growth of sulfate reducing bacteria and to stimulate the more complete degradation by the methane bacteria.

30166 **(DOE/PC/70020—T1) Methane suppression in the Fischer-Tropsch synthesis: Final report.** Iyagba, E.T.;Nwalor, J.U.;Hoost, T.E.;Goodwin, J.G. Jr. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 31 Jan 1988. Contract AC22-84PC70020. 50p.

The objective of the project was to investigate the possiblity of modifying methane formation during the F-T synthesis independent from other hyfrocarbons by systematically changing catalyst characteristics. It would seem that the best way to decrease methane selectivity is still via the use of catalyst modifiers. Inorder to "tailor-make" catalyst surfaces which minimize "extraneous" methane synthesis without disrupting F-T synthesis, it is necessary for us to fully understand the mechanism(s) by which such modifiers operate. An investigation of Fischer-Tropsch synthesis on K- and Cl-modified Ru Catalysts was carried out. The steady-steady reaction results illustrate how chlorine enhances the selectivity of methane formation while potassium decreases it. In order to better understand methane slectivity changes, a detailed study of Cl-modification of Ru catalysts was made. Amonnia synthesis and methanation reaction results on the same series of catalysts (obtained by using the steady-state isotopic transient technique) in addition to the deactivation results for F-T suggest that structural rearrangements induced by the presence of chlorine, rather than selective site blocking or electronic interactions, may be the primary mechanism of chlorine modification of supported ruthenium catalysts. The results of this study indicate that catalyst modifiers may act to change the catalytic properties by inducing certain metal surface structures. This is a mechanism of modification which has, yet, not been addressed in detail. 49 refs., 16 figs., 7 tabs.

30167 **(DOE/PC/70024—T14) Synthesis gas solubility in Fischer-Tropsch slurry: Technical progress report, January 1, 1986-March 31, 1986.** Chao, K.C. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1986. Contract AC22-84PC70024. 26p.

This is the quarterly progress report for the first quarter of 1986, January through March, on Synthesis Gas Solubility in Fischer-Tropsch Slurry. Experimental determination of solubility of CO in two n-paraffin solvents was completed. We present the solubility data that we have determined for five gases in two paraffin solvents in ten tables. The solubility data have been correlated with three cubic equations of state employing van der Waals quadratic mixing rules. The correlation development is being continued. Preparation has been made to measure solubility of mixed H_2CO gas in n-paraffin solvents. 8 figs., 14 tabs.

30168 **(DOE/PC/70024—T17) Synthesis gas solubility in Fischer-Tropsch slurry: Technical progress report, October 1, 1986-December 31, 1986.** Chao, K.C. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1986. Contract AC22-84PC70024. 17p.

Solubility data were determined for ethylene in n-eicosane and for hydrogen, carbon monoxide, carbon dioxide, methane, and ethane in n-hexatriacontane. Interaction constants in the modified Soave equation were determined and correlated for the solubility of hydroen, carbon monoxide, methane, ethane, and carbon dioxide in n-paraffin solvents. 12 figs., 1 tab.

30169 **(DOE/PC/70030—T9) Novel Fischer-Tropsch slurry catalysts and process concepts for selective transportation fuel production: Final report.** Withers, H.P. Jr.;Eliezer, K.F.;Mitchell, J.W. (Air Products and Chemicals, Inc., Allentown, PA (USA)). Dec 1987. Contract AC22-84PC70030. 132p. NTIS, PC A07; 3; GPO Dep. Order Number DE88004678/JAW.

The preparation, characterization and performance of cobalt and ruthenium carbonyl cluster-based catalysts for use in slurry-phase Fischer-Tropsch (FT) technology was investigated. The use of metal carbonyls as active metal precursor allows for the possible control of metal particle size on the support surface and thus offers the potential for better control of activity and selectivity of the FT reaction. Accomplishments included reproducible catalyst preparation, improvements in activity by use of a silica support, understanding diffeences between nitrate and carbonyl precursors, a nd good activity maintenance in the slurry reactor. A $CO_2(CO)_8Zr(OPr)_4SiO_2$ catalyst (3.5% CO, 6.6% Zr) was developed as the most active system in the slurry reactor and also gave the best liquid fuel selectivity. Silica support provided the highest catalyst activities. This catalyst was successfully tested in an extended slurry-phase run that achieved 6 months on stream with a 10% loss in activity. Ru catalysts showed the highest activity in the fixed-bed reactor but deactivated rapidly in the slurry reactor. In the analysis of the kinetic data, catalyst deactivation was assumed to proceed linearly between baseline experients at fixed temperture. Causes of the deactivation are not fully understood. 27 refs., 37 figs., 20 tabs.

30170 **(DOE/PC/79814—T1) Methane conversion process evaluations: Screening study.** (Bechtel National, Inc., San Francisco, CA (USA)). 1988. Contract AC22-87PC79814. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88007944/JAW.

The objective of this screening study is to select three methane to liquid hydrocarbon processes and to define the design bases to be used for a more detailed design and cost evaluation. Emphasis is placed on direct conversion processes (avoiding the use of synthesis gas) though a brief review has been made of potential improvements in synthesis gas production. The result is the selection of the following process combinations for more detailed study: (1) oxidative coupling using circulating catalyst plus oligomerization (ARCO data);(2) oxychlorination plus oligomerization (PETC data);(3) partial oxidation plus oligomerization (several sources). There have also been advances in methanol sysnthesis gas technology which will impact the basis on which direct conversion technologies are compared in the future. Table 2 compares conventional methanol with new technologies being proposed by Davy McKee, Lurgi, Brookhaven Labs and others. The key improvemnt in each case is a less expensive way of producing stoichiometric synthesis gas. A 20% reduction in capital cost and a 1 MM Btu/ST improvement in thermal efficiency over conventional methanol is considered readily achievable. Table 3 shows approximately to what degree improved synthesis gas technology could improve cost and efficiency of liquid hydrocarbon production applying the cost reduction and efficiency improvement indicated above for methanol. While the improvement is substantial, it will not be sufficient to develop an overriding economic potential and it is deemed more important to define the economics of the three direct conversion technologies. 14 references,4 figs., 6 tabs.

30171 **(DOE/PC/80015—9) Fischer-Tropsch slurry phase process variations to understand wax formations: Quarterly report for period October 1, 1987 to December 31, 1987.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract AC22-85PC80015. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007210/JAW.

Effects of high syngas conversion on the secondary reactions of olefins formed by Fischer-Tropsch synthesis on a reduced fused magnetite catalyst were simulated by studies of olefins in the presence of hydrogen and low concentrations of CO, or none at all. kinetic models were developed for the effect of CO partial pressure on hydrogenation rates at 232{degree}C and 0.30 to 0.79 MPa. In the absence of carbon monoxide, olefin hydrogenation was more rapid than in its presence. A model indicated that a hydrogenated carbon monoxide species on the catalyst may be responsible for the inhibition of olefin hydrogenation, and that olefin adsorption is rate-limiting. The formation of secondary olefins appeared to follow similar trends with carbon monoxide partial pressure. Olefin incorporation was not observed in the small amount of Fischer-Tropsch products obtained in these experiments. The chain growth probability, alpha, appeared to correlate with the H_2CO feed ratio. 14 refs., 13 figs., 1 tab.

30172 **(DOE/PC/80015—10) Fischer-Tropsch slurry phase process variations to understand wax formations: Quarterly report, January 1, 1988-March 31, 1988.** Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge (USA)). 1988. Contract AC22-85PC80015. 28p.

A method has been developed for caluclating the three parameters needed to characterize the carbon number distribution of products of the Fischer-Tropsch synthesis. using non-linear regresion, experiemental data are fit by a modified Schulz-Flory model which has two chain growth probabilities. Excellent fit is shown for data from precipitated and fused iron catalysts. The model is used to calculate selectivity information of interest in catalyst comparison and reactor design. Advantages of this model over asymptotic regression methods are discussed in detail. 26 refs., 6 figs.

30173 **(PNL-SA—15622) Production costs of hydrocarbon fuels from biomass.** Stevens, D.J.; Wan, E.I. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 27p. (CONF-880215—3).

From Energy from biomass and wastes; New Orleans, LA, USA (15 Feb 1988).

Biomass is an important energy resources at present and offers excellent potential for increased energy impact in the future. This energy impact is expected to be achieved in part by liquid transportation fuels derived from biomass. Liquid fuels are more energy dense than biomass itself and more closely match existing end-use patterns. The US Department of Energy's (DOE) Biofuels and Municipal Waste Technology Division is sponsoring research on the production of liquid hydrocarbon fuels from biomass. these fuels are generated by first converting the biomass resource to biocrude oils and then upgrading those to hydrocarbon products. This paper presents an evaluation of production costs for hydrocarbon fuels from two advanced biomass-to-gasoline processes being sponsored by DOE. These include one conceptual process where biomass is rapidly pyrolyzed and the resulting biocrude oil is hydrotreated to gasoline hydrocarbons. A second conceptual process is also considered where biomass is pyrolyzed and the intermediate biocrude vapors are upgraded over zeolite catalysts. A technoeconomic analysis is performed for these two concepts based both on curretly attainable experimental results as well as projected results assumed to be attainable with additional research. 9 refs., 10 figs., 8 tabs.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 30423

30174 (CONF-8605117—, pp 45-51) **US ethanol: its historical, present, and future growth.** McIlroy, D.L. (Agricultural Products Utilization Commission, Bismarck, ND (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the historical developments of ethanol in the US. It describes the problems this fuel faced when it was initially developed and how these problems of public opinion, fuel versus food, and acceptance. It then discusses the governmental incentives that were used to help develop this energy source from surplus food stock. It also discusses problems faced by developing countries trying to utilize ethanol fuels. A discussion of ethanol use by major oil companies to reach the desired octane level is also provided.

30175 (CONF-8605117—, pp 52) **New look at ethanol.** Thornberg, R.R. (Dawn Enterprises, Walhalla, ND (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper describes the economic crisis now affecting the ethanol fuel industry because of the drop in oil prices. It briefly outlines several needs for the industry to survive. These include greater emphasis on feed products from the processed grain, improved process economics, work toward lead credits in the octane market, and creative application of new biotechnology advances.

30176 (CONF-8605117—, pp 60-64) **Chemical modification of vegetable oil for the production of agricultural diesel fuel.** Hassett, D.J. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

The University of North Dakota Engineering Experiment Station is currently engaged in research on the use of chemically modified vegetable oils as replacement agricultural diesel fuels. Direct injection diesel engines, which are widely used in agriculture, experience a variety of fouling problems when operated on unmodified vegetable oils. These problems such as sticking rings, fouled injectors, and varnish build-up on cylinder walls, appear to be partially related to poor injector performance caused by the relatively high viscosity of vegetable oils. The formation of lower alcohol esters is an effective chemical means to reduce viscosity. Current research has focused on the production and use of sunflower oil methyl ester. Physical and chemical properties of this fuel at several degrees of refinement were used to determine fuel properties. Engine testing indicated that fuel grade sunflower oil methyl ester, defined as sunflower oil converted to methyl ester of at least 90% purity, had about the same tendency to foul a direct injection diesel engine as number 2 diesel fuel. A pilot plant for the production of fuel grade vegetable oil methyl ester has been designed and constructed. This plant produces 500 gallon batches of fuel grade sunflower oil methyl ester. At the time of the writing of the report, over 3000 gallons of fuel grade sunflower oil methyl ester have been produced in this pilot plant.

30177 (ORNL/Sub—85-22007/4) **Status of alcohol fuels utilization technology for highway transportation: A 1988 perspective: Volume 1, Spark ignition engines.** (Mueller Associates, Inc., Baltimore, MD (USA)). Feb 1988. Contract AC05-84OR21400. 240p.

The current status of the technologies of alcohol utilization in highway transportation spark ignition engines is reviewed. The use of methanol, ethanol and higher alcohols as neat fuels and in blends is reviewed in this volume. The topics covered include fuel properties, engine performance, vehicle driveability, exhaust emissions, materials compatibility, and environmental, health and safety considerations. The status of the technology at the time of the last comprehensive study (1981) is summarized and discussed. Significant advances made since 1981 are discussed. Remaining information gaps and areas in which more extensive investigation is needed are identified. 63 figs., 46 tabs.

0903 Inorganic Hydrogen Compound Fuels

REFER ALSO TO CITATION(S) 29866

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 30198, 30421, 30424, 30426

30178 (CONF-8605117—, pp 56-59) **Sunflower residue as an energy source.** Lindley, J.A. (North Dakota State Univ., Fargo, (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Crop residue represents a potential valuable energy source. Methods of harvesting sunflower stalks were investigated. Residue collected has varied from 5% to 40% of the 1/2-2 tons available. Collection during seed harvest increased combining time. Briquetted sunflower stalks do not burn as easily and result in more ash than pelleted sunflower hulls. With the system, utilized combustion rate was more easily controlled with the briquettes and the conversion efficiency was higher (average of 61.9% compared to 55.4%).

13 HYDRO ENERGY

1301 Resources And Availability

REFER ALSO TO CITATION(S) 30402

30179 (CONF-8605117—, pp 159-164) **Manitoba's hydroelectric resources.** Goodwin, C.J. (Manitoba Hydro, Winnipeg (Canada)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Manitoba is at the geographic center of Canada, bordered on the east by Ontario and on the west by Saskatchewan. Extending north to Hudson Bay and south to Minnesota and North Dakota, its area of 251,000 square miles is nearly the size of Texas. The heart of Manitoba's hydroelectric potential is the Nelson River system. This watershed drains an area of 414,000 square miles - equal to the combined area of North and South Dakota, Minnesota, Wisconsin and Michigan. In the US, only the Mississippi River has a larger drainage basin, while only the Mississippi and Columbia Rivers have larger water flows. Lake Winnipeg, the world's thirteenth largest lake, serves as a natural reservoir for this vast drainage basin. The Nelson River, connecting Lake Winnipeg to Hudson Bay, provides the bulk of the province's current and potential hydroelectric generation. This paper discusses the development of these water resources.

1302 Site Geology And Meteorology

30180 **Sedimentation and the economics of selecting an optimum reservoir size.** Miltz, D.; White, D.C. (Univ. of Illinois, Urbana (USA)). *Water Resources Research;* **23**: No. 8, 1443-1448(Aug 1987).

An easily reproducible methodology is presented for the economic selection of an optimal reservoir size given an annual sedimentation rate. The optimal capacity is that at which the marginal cost of constructing additional storage capacity is equal to the dredging costs avoided by having that additional capacity available to store sediment. The cost implications of misestimating dredging

costs, construction costs, and sediment delivery rates are investigated. In general, it is shown that oversizing is a rational response to uncertainty in the estimation of parameters. The sensitivity of the results to alternative discount rates is also discussed. The theoretical discussion is illustrated with a case study drawn from Highland Silver Lake in southwestern Illinois.

1303 Plant Design And Operation

30181 (DOE/ID/12124—1) Small-scale hydroelectric power demonstration project: Boott Hydropower, Inc. Eldred L. Field Hydroelectric Project: Final technical and construction cost report. (Boott Hydropower, Inc., Lowell, MA (USA)). Mar 1988. Contract FC07-80ID12124. 117p.

The Lowell Hydroelectric Project (Eldred L. Field) is a key feature of the Departments of Energy's National Low Head Hydroelectric Power Demonstration Program. This report summarizes the Project's Construction which began in October 1983 and was completed in November 1985. It also details project construction costs.

1306 Environmental Aspects

30182 (DOE/BP/11631—2) Smolt condition and timing of arrival at lower granite reservoir: Annual report for 1985 operations. Scully, R.J.; Buettner, E. (Idaho Dept. of Fish and Game, Boise (USA)). Mar 1988. Contract AI79-83BP11631. 78p.

This project monitored the daily passage of smolts during the 1985 spring outmigration at three migrant traps, one each on the Snake, Clearwater, and Salmon rivers. Yearling chinook migration rate between Salmon River release sites and the Salmon River scoop trap averaged 23 km per day, about half the migration rate for the same brand groups when migrating from the Salmon River trap to the Snake River trap (48 km/day). Average migration rates for branded chinook and steelhead between release sites and the head of Lower Granite Reservoir were both near 27 km per day. The yearling chinook migration begins in earnest when Salmon River discharge makes a significant rise in early to mid-April. Most yearling chinook pass into Lower Granite Reservoir in April followed by passage of steelhead in May. Chinook smolt recapture data from the Snake River trap suggest a strong dependence of migration rate on quantity of Snake and Salmon river discharge. The ability of the Salmon River trap to catch yearling chinook decreased as discharge increased. No correlation between discharge level and efficiency was observed at the Snake or Clearwater trap for chinook or steelhead smolts. When comparing the size of smolts in the Salmon and Clearwater rivers, the former river has smaller yearling chinook and larger hatchery and wild steelhead. Salmon River hatchery steelhead smolts in 1985 averaged 2 cm smaller than in 1983 and were much healthier than in 1983. 4 refs., 32 figs., 18 tabs.

30183 (DOE/BP/11887—4) Evaluation of a low-cost salmon production facility: Annual report FY 1987. Hill, J.M.; Olson, T. (Clatsop Economic Development Committee Fisheries Project, Astoria, OR (USA)). Feb 1988. Contract AI79-83BP11887. 45p.

Activities of the study include investigating the potential for community involvement; evaluating natural outmigration of smolts; providing cumulative production of quality salmon; aiding in development of optimum density levels in earthen rearing ponds; and augmenting a unique "known stock" fishery. The coded-wire tagging program was continued to aid in the accomplishment of the objectives. Monitoring of downstream smolt migration from CEDC release sites continued. Data collected is beginning to show that smolt size and stream flow have an effect on smolt migration. Release of comparatively larger smolts and release during elevated stream flows, demonstrates a more rapid migration. Release of larger smolts also enhances adult survival. Smolts released at 9.5 fish/pound suvived by nearly ten times that of smolts released at 16.3 fish/pond and by nearly 5 1/2 times when released at about 13.5 fish/pound. In 1987 the CEDC Fisheries Project reared and released a total of approximately 1.7 million salmon smolts. Coho production was about 300,000, fall chinook at about 1.4 million, and Rogue stock fall chinook a a minimal 20,000. Preliminary overall adult survival figures for 1987 show a 0.69% for tule chinook, 2.89% for Rogue stock fall chinook, and 0.82% for coho. Chinook survival was up from previous years, whereas coho survival appears to be down. 1 ref., 8 figs., 19 tabs.

30184 (DOE/BP/13084—4) Pen rearing and imprinting of fall chinook salmon: Annual report, 1987. Nelson, W.R.; Novotny, J.F.; Macy, T.L.; Faler, M.P.; Beeman, J.W.; Burley, C.L. (Fish and Wildlife Service, Cook, WA (USA). Willard Field Station; Fish and Wildlife Service, Vancouver, WA (USA). Vancouver Fisheries Assistance Office). Dec 1987. Contract AI79-83BP13084. 78p.

The 1987 field season was the third and final year for the rearing and release of juvenile upriver bright chinook salmon (Oncorhynchus tshawytscha) at off-station sites. Disease problems in the hatchery where fish for the study were spawned and hatched resulted in the movement of trials to Drano Lake, a backwater located near river km 261, 105 km downstream of Rock Creek and 205 km downstream of Social Security Pond, the two off-station rearing sites where studies were completed in 1984-86. Fish in fed treatments were successfully reared in pens during March, April, and May and were released in the third week of May at a mean size of about 4.5 g (100/lb). Growth and physiological development of fish reared in Drano Lake were only slightly faster than observed in hatchery controls over much of the rearing period. However, during the final two weeks of rearing, ATPase activities and growth of the fish reared in pens increased, and at release the fed treatments tested in Drano Lake were significantly larger, and physiological development was significantly ahead of hatchery controls. 14 refs., 10 figs., 12 tabs.

30185 (DOE/BP/18010—1) Effects of vitamin nutrition on the immune response of hatchery-reared salmonids: Annual report, FY 1987. Leith, D.; Newman, M.; Kaattari, S.; Holland, N.; Dekoning, J. (Abernathy Salmon Culture Technology Center, Longview, WA (USA); Oregon State Univ., Corvallis (USA). Dept. of Microbiology). Dec 1987. Contract AI79-84BP18010;AI79-84BP18007. 76p.

We are studying effects of vitamin nutrition on immunity and disease resistance in chinook salmon (Oncorhynchus tshawytscha). The long range goal of this project is to define the dietary levels of pyridoxine, folic acid, pantothenic acid, riboflavin, ascorbic acid and vitamin E required to assure maximum resistance to disease. In the third year of this study we have completed the vitamins riboflavin and pantothenic acid. We first approximated dietary concentrations of these vitamins that would exert the greatest effects on the immune response of salmon. Appropriate vitamin concentration ranges for both vitamins were then tested in a practical (Abernathy diet) and a semi-purified (modified Oregon Test Diet) ration to determine what concentration of vitamin would be required to gain some beneficial effects in a practical feed, and to determine the absolute requirements for immunological sufficiency. Results indicate that there are marginal differences in the immunological parameters tested with respect to the vitamin concentrations incorporated into the diets. However, the in vitro and in vivo studies indicate that the Abernathy diet can provide greater enhancement of the development of immune responsiveness over that seen with the semi-purified diet. This may be related to the increased growth rate or feed conversion of fish maintained on the Abernathy diet. 47 refs., 19 figs., 17 tabs.

30186 (DOE/EA—0307) The Colville Resident Trout Hatchery: Environmental assessment. (USDOE Bonneville Power Administration, Portland, OR. Office of Power and Resources Management). Aug 1986. 97p.

The Bonneville Power Administration (BPA) proposes to fund the design, construction, operation, and maintenance of a resident trout hatchery facility on the Colville Indian Reservation in southern Okanogan County, Washington (Figure 1-1). The Colville Resident Trout Hatchery project is the result of efforts by the Pacific Northwest Power Planning Council (NWPPC), BPA, and the Colville Confederated Tribes (CCT) to mitigate the loss of fisheries resources on the Columbia River, particularly on the Colville Reservation, that have resulted from construction of Grand Coulee and

Chief Joseph Dams. The CCT has cooperated in the preparation of the Environmental Assessment because the CCT will be responsible for management of the hatchery after its completion. 22 refs., 4 figs., 10 tabs.

30187 **(PNL-SA—15699) Fish behavior, migration and environmental assessment.** Gray, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 34p. (CONF-871146—1).

From 8. annual meeting of the Society of Environmental Toxicology and Chemistry; Pensacola, FL, USA (9 Nov 1987).

Studies at the Pacific Northwst Laboratory have evaluated fish behavior and migration in response to thermal discharge, gas supersaturated water, water-soluble fractions of coal liquids, and other environmental stresses. Major findings including thermal discharges did not block upstream migration of sonic-tagged adult chinook salmon (Oncorhynchus tschawytscha) and a rainbow trout (Salmo gairdneri) in the Columbia River. Juvenile chinook slamon avoided thermal discharges in the laboratory when Δts exceeded 9 to 11{degree}C above ambient. However juvenile salmon were more susceptible to predation at 10 to 20% of the thermal dose causing loss of equilibrium. Radio-tagged adult chinook salmon swam deeper in supersaturated water than in normally saturated water in the Snake River and, thereby, avoided the upper, critical zone. Carp (Cyprinus carpio) and black bullhead (Ictalurus melas) did not always avoid lethal gas levels in the laboratory and some fish died in the test apparatus. Fathead minnow (Pimephales promelas) avoided the water soluble fraction (WSF) of a coal liquid at concentrations causing acute effects but not at those causing chronic effects. Rainbow trout did not avoid coal liquid WSFs although they reportedly avid the major constituent, phenol, tested a as pure compound. Susceptibility to predation of juvenile rainbow trout did not increase until phenol concentrations reached the acute LC_{50}. 67 refs., 11 figs., 1 tab.

14 SOLAR ENERGY

1401 Resources And Availability

30188 **(SERI/PR—215-3297) Photovoltaic Advanced Research and Development Project, solar radiation research:.** Hulstrom, R.L.;Cannon, T.W.;Riordan, C.J. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1988. Contract AC02-83CH10093. 31p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88001143/JAW.

This report summarizes work performed in FY 1987 by SERI's Resource Assessment and Instrumentation Branch, Solar Electric Research Division, under the Solar Radiation Research Task of the Photovoltaic Advanced Research and Development Project. The objectives of this task are to implement improved spectral solar radiation models and data bases, and to develop specialized instrumentation/ measurement techniques needed to help develop a technical understanding of the relationships between photovoltaic device performance and outdoor spectral solar radiation variations. 19 refs., 14 figs., 1 tab.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 30173, 30429, 30678, 31182, 31183, 31183, 31195

30189 (CONF-8605117—, pp 170-179) **Doped amorphous silicon by thermal evaporation.** Makadsi, M.N.; Al-Hadad, R.M.S. (Baghdad Univ. (Iraq)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Amorphous silicon thin films have been prepared by thermal evaporation under high vacuum at different substrate temperatures and controlled deposition parameters. The pure films were p-type semiconductor, but with low charge concentration. As and In have been used as dopant material to obtain n- and p-type respectively. The best conductivity and Hall mobility were obtained at 3% impurity for both As and In. The effect of annealing temperature has been well investigated. Annealing in the temperature range 300-873°K resulted in the increase of the energy gap of pure a-Si, a-Si + 3% As, a-Si + 3% In by 0.2, 0.08 and 0.35 respectively. The activation of conduction through the temperature range 300-523°K, has shown to have more than one value for pure n- and p-type a-Si. The electrical conductivity of a-Si films prepared under controlled conditions are shown to have stable properties. Solar cells p-n junction have been attempted and examined, their results were encouraging.

30190 **(DOE/CE/15270—T5) Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, January 1, 1988 to March 31, 1988.** Garrett, H.E.; Reid, R.K.; Sword, M.A. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1988. Contract FG01-86CE15270. 13p.

This study was undertaken to determine if boron and IAA applied in combination to the roots of nonmycorrhizal shortleaf pine seedlings results in a greater downward flux of sucrose than when each is applied independently. Carbon 14 content of pine root systems were analysed as a complet randomized block experiment with 5 blocks, 4 IBA levels, and 4 boron levels. Originally, two time periods were included and analyzed as a split plot, but no difference in ^{14}C content was found between the two times, and time was dropped as a effect and data combined for further analysis. The only effect on ^{14}C transport to the roots was due to IAA concentration, but that effect was not as expected.

30191 **(DOE/CH/10093—H4) Photovoltaic energy systems: Program summary, Fiscal year 1987.** (Solar Energy Research Inst., Golden, CO (USA)). Feb 1988. Contract AC02-83CH10093. 238p.

An overview is provided of the activities within the National Photovoltaics Program. Tasks conducted by the participating national laboratories or under contract by industrial, academic and other research institutions are highlighted. Activities initiated, renewed, or completed during Fiscal Year 1987 are covered. The listing for each activity provides the task title, objectives, approach, status and accomplishments, milestones, major project reports, the name of the contractor and principal investigator, the directing organization, and the contract funding information. Publications for FY86-87 are also listed.

30192 **(DOE/ER/10903—8) Phytochrome from green plants:.** Quail, P.H. (Wisconsin Univ., Madison (USA)). 1 Mar 1988. Contract AC02-81ER10903. 18p.

This research has been directed toward characterizing and purifying the molecular species of phytochrome detected in green Avena tissue. We have found major differences between the phytochrome extracted from green and from etiolated tissue as regards immunochemial and spectral properties. In addition, we have established: (a) that the predominant ({approximately}80% of total) phytochrome polypeptide in green tissue has a relative molecular mass (Mr) of 118,000;(b) that the proteolytic peptide map of this 118,000-Mr species differs considerably from that of 124,000-Mr phytochrome from etiolated tissue;(c) that the green-tissue, 118,000-Mr polypeptide carries only one of three spatially separate epitopes that are present on etiolated-tissue phytochrome (i.e., an epitope in the carboxy-terminal domain recognized by Type 3 monoclonal antibodies);(d) that the minor phytochrome species in green tissue ({approximately}20% of total) resembles that in etiolated tissue in that it is 124,000-Mr and is immunoprecipitable with polyclonal, anti-etiolated-oat-phytochrome antibodies, thereby accounting for the previously observed limited population of immunoprecipitable activity in green extracts;and (e) that the 118,000-Mr green-tissue molecule migrates on non-denaturing size exclusionchromatography as a {approximately}320 kDa entity, suggesting a quaternary structure similar to etiolated tissue 124,000-Mr phytochrome. A new purification protocol that enriches the green-tissue phytochrome {approximately}200-fold has been developed. The preparations obtained in this way are apparently free of residual endogenous proteolytic activity. We have examined the regulation of the level of the 118,000-MR species during seedling developement and have obtained evidence that the abundance of this species is not modulated

by light, in contrast to its etiolated-tissue counterpart. 12 refs., 7 figs., 1 tab.

30193 **(DOE/ER/13252—T2) [Analysis of the Rhizobium meliloti surface].** Signer, E.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 3 Mar 1988. Contract FG02-84ER13252. 3p.

We have identified a number of genes in Rhizobium meliloti that affect outer membrane lipopolysaccharides (LPS). These include three genes defined by mutants with different patterns of resistance to a panel of bacteriophages, of which Class 2 and 3 are closely linked to each other but not to Class 1 or 4;another gene, closely linked to Class 2 and 3, defined only by its ability to suppress Class 1 defects;and three genes, unlinked to each other, defined by mutants with increased sensitivity to deoxycholate. Of the mutants that define these genes, only those in Class 2 have a clear effect on alfalfa symbiosis, having a Fix phenotype.

30194 **(DOE/ER/13543—2) Soybean ribulose bisphosphate carboxylase small subunit; mechanisms and determinants of RNA turnover: Annual progress report for the period June 1, 1987 through May 31, 1988.** Meagher, R. (Georgia Univ., Athens (USA). Dept. of Genetics). 1988. Contract FG09-86ER13543. 13p.

SRS1 and SRS4 are two closely related soybean ribulose - 1,5-bisphosphate carboxylase small subunit (SSU) genes. The promoters from both SRS1 and SRS4 can be fused to a neomycin phosphotransferase gene and these fusions produce similar levels of kanamycin resistance in transgenic petunia plants. The expression of SRS1 and SRS4 has been shown to be controlled at the level of transcription, and this transcriptional control is phytochrome mediated. Together these genes account for 2-3% of the total transcription in light-grown soybean seedlings or expanding soybean leaves. Recent experiments analyzing transcription rates of SRS1 and SRS4, steady state levels of their total and poly A+ RNA and frequency of their cDNAs in a soybean RNA library have led us to hypothesize that the expression of these two genes may also be controlled at the level of RNA turnover. Despite the 30-50 fold difference in transcription of these genes in seedlings grown in light, the steady state levels of RNA are only 4-8 fold higher in the light. When plants are shifted from darkness to light, accumulation of RNA lags far behind the striking transcriptional induction. In plants shifted from light to darkness, SRS1 transcription takes 24 hours to drop to dark-grown levels, and the steady state RNA levels take 72 hours to decay to dark-grown levels. On the other hand light-grown plants treated with far-red light shut down SRS1 transcription immediately, and the steady state levels of SSU RNA also drop rapidly. We have evidence suggesting striking differential turnover of the RNA products of SRS1 and SRS4, the SRS1 RNA being perhaps 5-10 times more stable than the SRS4 RNA.

30195 **(DOE/ER/13543—T1) Differential transcription and message stability of two genes encoding soybean ribulose 1,5-bisphosphate carboxylase small subunit.** Shirley, B.W.; Berry-Lowe, S.L.; Grandbastien, M.A.; Zurfluh, L.L.; Shah, D.M.; Meagher, R.B. (Georgia Univ., Athens (USA). Dept. of Genetics; Monsanto Co., St. Louis, MO (USA); Carlsberg Lab., Copenhagen (Denmark); Biologie Cellulaire, 78 - Versailles (France)). 13 Mar 1987. Contract FG09-86ER13543. 22p.

The expression of two closely related soybean ribulose bisphosphate carboxylase small subunit (Rubisco ss) genes, SRS1 and SRS4, has been compared. These genes account for approximately 2-4% of the total transcription in light grown leaves, SRS4 being twice as transcriptionally active as SRS1. The transcription of these genes is reduced more than 30 fold after a pulse of far-red light or extended periods of darkness. When etiolated seedlings are shifted to the light the transcription of both genes increases 30-50 fold. Despite this 30-fold range in transcriptional expression the steady state mRNA levels in light and dark grown tissue differ by less than 8 fold. This suggests that the mRNAs are less stable in light grown tissue. 38 refs., 5 figs.

30196 **(DOE/ER/13704—1) Processing and targeting of the thiol protease aleurain: Progress report.** Rogers, J.C. (Washington Univ., St. Louis, MO (USA)). 1988. Contract FG02-87ER13704. 6p.

This study addresses the processing and targeting of the thiol protease aleurain in monocots. A probe derived from the aleurain cDNA specific for the 5'-most 400 bp (a region encoding the first 140 amino acids of the preprotein hybridized to at least 3 separate elements in the barley genome; only one represented the aleurain gene. In contrast, a probe specific for the remaining 2/23 of the cDNA (representing the protease domain) hybridized to only a single copy sequence. To know if this pattern pertained in other, closely related, monocots, we probed Southern blots of genomic DNA from maize, rye, oats, sorghum, and pearl millet with each probe. In each instance except for maize DNA, the 5' domain probe hybridizes to several fragments in addition to those identified by the protease domain probe. Presumable the darkest hybridization in each represents the fragment carrying the sequences homologous to barley aleurain. The fragments from a given restriction enzyme identified by the protease domain probe in sorghum, millet, and maize, were indistinguishable in size indicating that the gene sequences, as well as flanking DNA, are so well conserved among the group that the location of the hexanucleotide sequences have not diverged. (3 refs., 3 figs.)

30197 **(DOE/OR/21390—17) Great Lakes Regional Biomass Energy Program:.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Feb 1988. Contract FG05-83OR21390. 96p.

This is the annual report of the fourth year of operation of the Great Lakes Regional Biomass Energy Program. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the publicand private sectors in the seven state Great Lakes region. States that are in the Great Lakes region include: Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues an needs. The third is the In-Houe Technology Transfer Program in which Council staff develop biomass energy publications and reports.

30198 **(DOE/OR/21390—18) Great Lakes Regional Biomass Energy Program:.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). Mar 1988. Contract FG05-83OR21390. 31p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007560/JAW.

This is the first quarterly report of the fifth year of operation of the Great Lakes Regional Biomass Energy Program. Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. During this quarter under the State Grant Program, two waste-to-energy workshops were sponsored by Iowa and Illinois attracting over 200 attendees. Michigan and Wisconsin continued their successful efforts to convince energy users in the state to convert to wood fuels. Michigan used oil overcharge funds to sign wood energy design grants with five public facilities and Wisconsin performed three wood energy analyses. Minnesota began work on an waste-to-energy guidebook for municipal leaders, while Ohio held its first biomass Advisory Council meeting.

30199 **(N—88-19413) Results of the 1987 NASA/JPL balloon flight solar cell calibration program.** Anspaugh, B.E.; Weiss, R.S. (Jet Propulsion Lab., Pasadena, CA (USA)). Dec 1987. 39p. (NASA-CR—182617; JPL-PUB—87-44; NAS—1.26:182617). NTIS, PC A03/MF A01.

The 1987 solar cell calibration balloon flight was successfully completed on August 23, 1987, meeting all objectives of the program. Forty-eight modules were carried to an altitude of 120,000 ft (36.0 km). The cells calibrated can now be used as reference standards in simulator testing of cells and arrays.

30200 **(PB—88-176334/XAB) Technical and economical feasibility of buffalo gourd as a novel energy crop. Final report, 14 November 1983-31 December 1986.** Goldstein, B. (New Mexico State Univ., Las Cruces (USA). New Mexico Solar Energy Inst.). Feb 1988. 243p. NTIS, PC A11/MF A01.

The New Mexico Solar Energy Institute has conducted a two-year investigation into the technical and economic feasibility of using the buffalo gourd plant as an energy feedstock in eastern New Mexico. The studies indicate that buffalo gourd is well suited for root production in eastern NM. Buffalo gourd has been shown to be an excellent feedstock for ethanol production provided necessary pre-fermentation processing (chopping of roots) is performed correctly. A model was created to determine the economic feasibility of growing buffalo gourd in eastern NM. It was determined that the net return to a farmer in eastern NM can be higher planting buffalo gourd than many traditionally grown crops because of buffalo gourd's low water and fertilizer requirements. A clearly defined R&D agenda and commercialization strategy is presented and discussed. Buffalo gourd has been demonstrated to have high potential as an alternative feedstock for ethanol production in eastern NM.

30201 **(PB—88-186416/XAB) Fast parametrization procedure for solar cells.** Lund, P.D.; Pylkkaenen, T. (Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics). 15 Jul 1987. 22p. (TKK-F-A—615). NTIS, PC E03/MF A01.

A simple mathematical procedure is presented for parameterization of the temperature-dependent solar cell current-voltage characteristics by using standard measured data. The silicon cells studied here are described by five parameters. The method was applied to several different photovoltaic modules, the inaccuracy of fit being less than 1.0% in all studied cases. On a IBM XT PC compatible microcomputer, a parameter fit requires an average 50-100 seconds. The model is well applicable for engineering purposes.

30202 **(SERI/TR—211-3317) Hydrogenated amorphous silicon-germanium alloys.** Luft, W. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1988. Contract AC02-83CH10093. 121p.

This report describes the effects of the germanium fraction in hydrogenated amorphous silicon-germanium alloys on various parameters, especially those that are indicators of film quality, and the impact of deposition methods, feedgas mixtures, and other deposition parameters on a SiGe:H and a-SiGe:H:F film characteristics and quality. Literature data show the relationship between germanium content, hydrogen content, deposition method (various glow discharges and CVD), feedgas lmixture, and other parameters and properties, such as optical band gap, dark and photoconductivities, photosensitivity, activation energy, Urbach parameter, and spin density. Some of these are convenient quality indicators; another is the absence of microstructure. Examining RF glow discharge with both a diode and triode geometry, DC proximity glow discharge, microwave glow discharge, and photo-CVD, using gas mixtures such as hydrogen-diluted and undiluted mixtures of silane/germane, disilane/germane, silane/germaniumtetrafluoride, and others, it was observed that hydrogen dilution (or inert gas dilution) is essential in achieving high photosensitivity in silicon-germanium alloys (in contradistinction to amorphous hydrogenated silicon). Hydrogen dilution results in a higher photosensitivity than do undiluted gas mixtures. 81 refs., 42 figs., 7 tabs.

30203 **Direct-current magnetron fabrication of indium tin oxide/InP solar cells.** Coutts, T.J.; Wu, X.; Gessert, T.A.; Li, X. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1722-1726(May 1988).

Interest in InP-based solar cells has recently been renewed due to the demonstration of excellent radiation resistance and the achievement of device efficiencies in excess of 20% (AM 1.5). Previous analysis of the indium tin oxide (ITO)/InP cell show it to be an extremely shallow homojunction which could, in principle, offer an even greater resistance to radiation than the deliberately grown organometallic chemical vapor deposition homojunctions. In this work, we have fabricated efficient solar cells of ITO/InP using dc magnetron deposition of the ITO into single-crystal InP substrates. The aim was to optimize the efficiency by varying the proximity of the substrate to the target and the input power to the plasma. Slight variations in efficiency have been observed but correlation with the fabrication parameters has been weak. Nevertheless, efficiencies over 16.5% have been achieved and verified at the Solar Energy Research Institute. This is the highest ever achieved for devices of this construction. Detailed studies of the annealing behavior of the cells have been made and interfacial changes observed using Raman spectroscopy and secondary ion mass spectroscopy. These observations, together with measurements of light and dark current/voltage, and quantum efficiency characteristics, have been used to model the behavior of the cells and explain their lack of sensitivity to the fabrication conditions.

30204 **Macroorganization of Chlorophyll a/b light-harvesting complex in thylakoids and aggregates: information from circular differential scattering.** Garab, G.; Faludi-Daniel, A.; Sutherland, J.C.; Hind, G. (Brookhaven National Lab., Upton, NY (USA)). *Biochemistry;* **27**: No. 7, 2425-2430(5 Apr 1988).

Circular dichroism (CD) and magnetic circular dichroism (MCD) spectra were recorded for spinach thylakoids and for isolated, aggregated chlorophyll a/b light-harvesting pigment-protein complex, in random and magnetically aligned states of orientation at room and low temperatures. The shape and magnitude of the CD signal of most bands strongly depended on the orientation of the thylakoid membranes or the aggregated pigment-protein complex. In both thylakoids and aggregated light-harvesting complexes, however, the MCD spectra of the two different orientations were almost identical. Random and magnetically aligned samples exhibited anomalous, large CD signals outside the bands of pigment absorbance. Lack of similarity between the corresponding MCD and CD spectra showed that the large CD signals are not produced as a distortion of CD of absorbance by light scattering. Instead, these anomalous spectral features are believed to originate in differential selective scattering of circularly polarized light. The results lead to the conclusion that the light-harvesting pigment-protein complex in thylakoid grana forms a helical macroarray with dimensions commensurate with the wavelengths of the anomalous circular dichroism signals. A hypothesis is put forward suggesting a role for these macrodomains in granal organization.

30205 **Reversible changes in macroorganization of the light-harvesting chlorophyll a/b pigment-protein complex detected by circular dichroism.** Garab, G.; Leegood, R.C.; Walker, D.A.; Sutherland, J.C.; Hind, G. (Brookhaven National Lab., Upton, NY (USA)). *Biochemistry;* **27**: No. 7, 2430-2434(5 Apr 1988).

Light-induced changes in circular dichroism (CD) were studied in thylakoids isolated from spinach. The following features of CD responses occurring in the time range of 10 s to 1-3 min were noted: (i) The kinetics and relative amplitudes of the responses are similar over broad spectral ranges surrounding the major CD bands, i.e., between 670 and 760 nm and between 480 and 550 nm. This applies not only to randomly oriented samples but also to magnetically aligned membranes having markedly different CD spectra in the dark. (ii) Photosystem I is much more effective than photosystem II and can drive a 40-80% decrease in CD signal relative to the dark control level. (iii) Photosystem I driven changes are fully inhibited by nigericin or NH_4Cl but are largely insensitive to gramicidin. CD changes driven by photosystem II, on the other hand, are sensitive to all of these reagents. (iv) The CD responses can be shown to originate in circular differential scattering rather than in circular differential absorbance. They can also be distinguished from light-induced, nonpolarized scattering changes. The data are qualitatively evaluated with respect to the theory of circular differential scattering of large helically organized macroaggregates, the size of which is commensurate with the wavelength of the measuring beam. The observed decrease of the large CD signal is ascribed to a partial loss of macrohelicity in the light-harvesting chlorophyll a/b protein complex, in response to a proton gradient and/or surface electrical field generated most effectively by photosystem I.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 30191, 30429, 30812

30206 **(DOE/CE/11968—T2) Plant performance for PV1 and PV2: SMUD [Sacramento Municipal Utility District] PV2, Final report 2, April 1986-March 1987.** Collier, D. (Sacramento Municipal Utility District, CA (USA)). Mar 1988. Contract FC03-83CE11968;FC03-82CE30701. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007286/JAW.

The Sacramento Municipal Utility Distric (SMUD) photovoltaic project is a phased installation of a 100 megawatt central station photovoltaic (PV) power plant that is being constructed adjacent to the Rancho Seco Nuclear Generating Station, 30 miles southeast of Sacramento, California. SMUD, with cofunding from the U.S. Department of Energy (DOE) and the California State Department of Enrgy has designed, procured, installed, and operated two 1,000 kilowatt power generating plants (PV1 and PV2) as the first two phases of the project (Figure No. 1). PV1 deferred for budgetary reasons and to evaluate new PV technologies. Long-range load projections for the SMUD service area indicate theneed for new peaking power generation. Plans prior to the initiation of this project included coal-fired, hydroelectric and geothermal power plants. Environmental and permitting constraints within California introduced considerable uncertainty into the timing and cost of other generation options. This projectwas, therefore, initiated to proide an economic and technical basis for future electrical generation using solar energy. Ther performance data presented herein was measured, stored, and reduced by the onsite plant control and data acquisition computer.

1407 Solar Thermal Power Systems

30207 **(N—88-19000) Computer-aided modeling and prediction of performance of the modified Lundell class of alternators in space station solar dynamic power systems. Semiannual progress report, 15 August 1987-14 February 1988.** Demerdash, N.A.O.; Wang, R.H. (Clarkson Univ., Potsdam, NY (USA)). Mar 1988. 62p. (NASA-CR—182538; NAS—1.26:182538). NTIS, PC A04/MF A01.

The main purpose of this project is the development of computer-aided models for purposes of studying the effects of various design changes on the parameters and performance characteristics of the modified Lundell class of alternators (MLA) as components of a solar dynamic power system supplying electric energy needs in the forthcoming space station. Key to this modeling effort is the computation of magnetic field distribution in MLAs. Since the nature of the magnetic field is three-dimensional, the first step in the investigation was to apply the finite element method to discretize volume, using the tetrahedron as the basic 3-D element. Details of the stator 3-D finite element grid are given. A preliminary look at the early stage of a 3-D rotor grid is presented.

30208 **(SAND—87-2502C) Design of a redirector/reconcentrator for use at the Central Receiver Test Facility.** Ghanbari, C.M.;Mulholland, G.P.;Otts, J.V. (Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); New Mexico State Univ., Las Cruces (USA); Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 6p. (CONF-880457—4). NTIS, PC A; 02; GPO Dep. Order Number DE88006661/JAW.

From 10. annual American Society of Mechanical Engineers solar energy conference; Denver, CO, USA (10 Apr 1988).

The Central Receiver Test Facility (CRTF), operated for the Department of Energy by Sandia National Laboratories in Albuquerque, New Mexico, was constructed for the purpose of evaluating solar central receiver design concepts. The facility consists of an array of 222 hilostats in a north-field configuration that reflects and ficuses the sun's energy toward a towaer 60 m high. Throughout the history of the CRTF, there has been an interest in beam redirectors or reconcentrators. The objective for this paper is to discuss the numerous code modifications required for the facility code HELIOS to be able to model the redirector-radome configuration. Note that this particular geometry was one that we had been asked to irradiate with energy from a redirector;however, the general model is applicable to any geometry. The model simulates the solar flux-density pattern from reflecting concentrators and follows the incident solar radiation through the atmosphere, the collection system, and finally onto the target. The model includes most pertinent factors that influence the optical performance of a collector system. Although the standard uotput contains information concerning sun shape distributions the atmospheric attenuation, probably the most useful output is the flux-density pattern at a grid of points on a receiver surface and the integral of this distribution over the surface to obtain power. 3 refs., 5 figs., 2 tabs.

30209 **(SAND—87-8181) Integrated solar reforming for thermochemical energy transport.** Rozenman, T. (Resource Analysis International, Inc., Los Angeles, CA (USA)). Dec 1987. Contract AC04-76DR00789. 161p. NTIS, PC A; 08/MF A01; GPO Dep. Order Number DE88005010/JAW.

This report presents a design study of two reforming processes as applied to the concept of solar thermochemical energy transport. Conceptual designs were carried out for steam-methane and CO2-methane reforming plants. A solar central receiver reformer was designed as an integrated reactor with the chemical reaction tubes placed inside the receiver cavity. The two plant designs were compared for hteir energy efficiency and capital cost. The CO2 reforming plant design results in higher energy efficiency but requires a catalyst which is still in an experimental stage of development. A third design was performed as a modification of the steam reforming plant utilizing a 'Direct Contact' system, in which the process steam is generated by utilizing the heat of condensation. This system resulted in the highest energy efficiency. A comparison of the capital cost of these three plant designs shows them to be equivalent within the estimation accuracy of 25{percent}. 10 refs., 56 figs., 34 tabs.

30210 **(SAND—88-8100) Central Receiver Plant Evaluation: IV, THEMIS Thermal Storage Subsystem Evaluation.** Amri, A.; Izygon, M.; Tedjiza, B. (Sandia National Labs., Albuquerque, NM (USA); Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Feb 1988. Contract AC04-76DR00789. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006993/JAW.

This report presents an evaluation of the salt thermal storage subsystem of THEMIS. A description of the thermal storage subsystem is given and the operation procedures are presented. The heat losses of the system are evaluated on the basis of cool-down experiments. The heat losses are then checked with the ones deduced from analytical models. The efficiency of the heat storage for a daily complete charge/discharge cycle is estimated to 95%. The thermal storage behavior is then described and analyzed over a complete day of actual operation. Finally the maintenance activity during two years of operation are listed and some remarks are made on salt corrosion, salt stability and the lessons learned by the construction and operation of this system. 7 refs., 33 figs., 13 tabs.

30211 **(SAND—88-8101) Central Receiver Plant Evaluation: 3, THEMIS receiver subsystem evaluation.** Amri, A.; Izygon, M.; Tedjiza, B. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Feb 1988. Contract AC04-76DR00789. 137p.

This report is part of the evaluation work carried out at Ecole Centrale on central receiver plants. The THEMIS receiver subsystem is evaluated with emphasis given to the energy performance problems. The report (1) describes the reasons for the choice of a molten cavity and its design points; (2) describes the receiver subsystem; (3) describes the receiver's operating modes; (4) presents experimental data on typical operation; (5) presents data on transient operation; (6) presents computer simulation of the receiver; (7) compares experimental data with computer simulation; (8) describes measurement of heat loss; and (9) discusses maintenance problems. 22 refs., 42 figs., 35 tabs.

30212 **(SAND—88-8102) Central Receiver Plant Evaluation:.** Amri, A.;Izygon, M.;Tedjiza, B. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DR00789. 151p. NTIS, PC A; 08/MF A01; GPO Dep. Order Number DE88007165/JAW.

This report is part of the evaluation work carried out at Ecole Centrale on central receiver plants. THEMIS system peformance is evaluated with emphasis given to energy production. The daily energy production is established on the basis of both plant modelization and actual plant production results. This analysis is performed at different levels of the system: receiver output, salt loop output, turbine-generator output and net plant output. In each case an input-output characteristic curve is established, considering the daily direct normal solar radiation as the input of the system. This input is defined for a given site by a meteo distribution, i.e. a yearly distribution of the daily direct normal solar radiation. The yearly plant production is then deduced by adding over the year the daily production calculated by combining the input-output characteristics with the meteo distribution of the considered site. Using this method, the energy production of THEMIS is estimated, assuming different meteorological conditions. The influence of the meteorological conditions and other parameters, on the plant output is finally discussed. 15 refs., 61 figs., 41 tabs.

1408 Ocean Energy Systems

REFER ALSO TO CITATION(S) 30429

1409 Solar Thermal Utilization

30213 **(INPE—4268-PRE/1141) Application of the estimation method to parameter performance date of solar water heating systems.** Gill, W.; Leite, A.O.P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 23p. (In several languages). NTIS, PC A03/MF A01.

It is well known that the performance of solar water heater systems depends totally upon ambient factors, which necessitates the use of mathematical models for the correct interpretation of experimental data. Here, we apply a statistical method to data obtained from four solar water heater systems to calculate their characteristic parameters. It was found that for a good estimate of these parameters it is necessary to have at least a 5-day observation period and further, at least 15 such periods.

30214 **(PB—88-175997/XAB) Evaluation of the feasibility of a multi-purpose solar roof still in the Virgin Islands.** Canoy, M.J.; Bullock, D. (Caribbean Research Inst., St. Thomas, VI. Water Resources Research Center). Sep 1983. 52p. (TR—18). NTIS, PC A04/MF A01.

One approach to the chronic water problems of the Virgin Islands would be widespread use of small solar stills to augment private water supplies. A study was done to: (a) identify critical resource and design factors; (b) estimate the local potential for solar distillation; (c) test the efficiencies of several designs; and (d) determine the production and economic potential of small locally built stills. The design parameters examined were: Deep vs. Shallow Basins, Glass vs. Plastic Covers, Roof vs. Flat Collectors, and rooftop placement. Results of the study shows that the solar energy in the Virgin Islands is not only at a high level but that the level is constant. In the stable Virgin Islands environment, the most-simple flat-plate, uninsulated collector is nearly as efficient as a complex expensive one. The lowest production was about 0.6 gal/sq ft/day; the highest 0.96 gal/sq ft/day. The average was about 0.8 gal/sq ft/day. Using the figure and 2 cents/gallon purchased water, a 20 sq ft still would supply 20% of a family's needs and have a payback period of less than one year.

1410 Solar Collectors And Concentrators

30215 **(DOE/SF/11922—T1) Thin film materials research for low cost solar collectors: Final technical report, September 28, 1983-March 31, 1987.** Spears, R.P.; Tretina, P.J. (Reynolds Metals Co., Richmond, VA (USA)). Mar 1987. Contract AC03-83SF11922. 625p.

This report summarizes the program activity in Thin Film Materials Research for Low-Cost Solar Collectors, US Department of Energy Contract No. DE-AC03-83SF11922, during the period September 28, 1983 to December 31, 1986. Activities, proceudres, and results are given in the areas of polymer film investigation, adhesive investigation, laminate process development, absorber coating investiation, absorber development, insulation investiation, collector development, and fabrication equipment design and operation. A comparison of results with program objectives is presented and shows that, while the target performance was achieved with the resultant design, the final collector cost could not be reduced to the target level due to material and operational constraints. Conclusions and recommendations regarding the directio of future research are also discussed.

30216 **(SAND—86-0927) CAV2: A PC-based computer program for predicting incident solar flux distributions inside dish cavity receivers.** Diver, R.B.;Andraka, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 70p. NTIS, PC A04. Order Number DE87006315/JAW.

The energy flux distribution at the aperture of cavity receivers is an important parameter that characterizes the performance of point-focusing solar concentrators. Together with simplifying assumptions about cavity absorptance, emittance, and convective losses, good estimates of the dish-receiver collection efficiency as a function of incident flux and effective cavity temperature can be obtained. For detailed design of cavity receivers, however, it is necessary to determine the incident flux distribution on the interior surfaces. This information is needed ultimately to determine the resulting energy fluxes to the working fluid, temperature distributions within the cavity, and receiver performance. Knowing the incident flux distributions provides the designer with insights such as where hot-spots are likely to occur, where heat exchange surfaces are needed, and where more detailed analysis might be warranted. Solar receivers are heat exchangers and incident flux distributions are a fundamental aspect of their design. The objective of this effort was to develop a design tool with which the effects of concentrator and receiver geometry on energy distributions could be investigated. The principal interest was in obtaining the overall flux distributions within arbitrarily shaped cavities. CAV was selected as a starting point for this development because of its availability and because it interfaces with a thermal analysis program called CVT. It also has the advantage that it can accommodate a number of internal surface orientations and has been shown to agree very well with more sophisticated computer programs.

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 30068

1503 Geothermal Exploration And Exploration Technology

30217 **(LA—11165-OBES) Lithologic descriptions and temperature profiles of five wells in the southwestern Valles caldera region, New Mexico.** Shevenell, L.; Goff, F.; Miles, D.; Waibel, A.; Swanberg, C. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 44p.

The subsurface stratigraphy and temperature profiles of the southern and western Valles caldera region have been well constrained with the use of data from the VC-1, AET-4, WC 23-4, PC-1 and PC-2 wells. Data from these wells indicate that thermal gradients west of the caldera margin are between 110 and 140{degrees}C/km, with a maximum gradient occurring in the bottom of PC-1 equal to 240{degrees}C/km as a result of thermal fluid flow. Gradients within the caldera reach a maximum of 350{degrees}C/km, while the maximum thermal gradient measured southwest of the caldera in the thermal outflow plume is 140{degrees}C/km. The five wells exhibit high thermal gradients (>60{deghrees}C/km) resulting from high conductive heat flow associated with the Rio Grande rift and volcanism in the Valles caldera, as well as high convective heat flow associated with circulating geothermal fluids. Gamma logs run in four of the five wells

appear to be of limited use for stratigraphic correlations in the caldera region. However, stratigraphic and temperature data from the five wells provide information about the structure and thermal regime of the southern and western Valles caldera region. 29 refs., 9 figs. 2 tabs.

30218 (LBL—24570) Potential field and electromagnetic studies: Introduction. Goldstein, N.E. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-8703199—4).

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

Several aeromagnetic surveys have been flown over Long Valley at different altitudes and line spacings. The one most often referred to was a high level (4 km or 13,200 feet above sea level barometric survey) flown by the USGS in 1973 along E-W lines spaced 1.7 km apart. Investigators attempted a quantitative interpretation of the data, and suggested that extensive post-caldera hydrothermal activity may have drastically altered the composition of the titanomagnetites in the Bishop Tuff, causing the magnetic low in the area of the resurgent dome. Others have reported in informal conversations, as is now supported by holes M-1 and 44-016, that the low in the western part of the caldera is the result of lower magnetization of the post-caldera volcanics and a large wedge of Paleozoic metasediments that floor the caldera. The true nature of the magnetic high on the eastern flank of the resurgent dome has been revealed by recent paleomagnetic work and from a detailed aeromagnetic survey flown 400 feet above terrain for the USGS in 1979. 6 refs., 2 figs.

1505 Economic And Financial Aspects

REFER ALSO TO CITATION(S) 30220

1506 Environmental Aspects And Waste Disposal

30219 (BNL—41118) Biological solutions to waste management. Premuzic, E.T.; Lin, Mow; Kukacka, L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880477—1).

From DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

The purpose of this program is to develop low-cost processes for the removal of toxic metals from geothermal residual brines. Processes and methodologies are also being developed for the utilization of detoxified residues. Laboratory work at Brookhaven National Laboratory (BNL) has shown that bioleaching is an efficient method for the removal of toxic metals from residual brine sludges. Samples of geothermal brine residues, supplied by the industry, containing elevated concentrations of heavy metals were treated with cultures of several strains of acidophilic bacteria Thiobacillus thioxidans and Thiobacillus ferrooxidans, selected from the BNL collection. The effect of different experimental conditions on the rate of toxic metal removal has been investigated. Based on the experimental results obtained, a detoxification process for geothermal brine residues has been explored. A preliminary technical feasibility study indicates that for a typical 50 MW plant, a large-scale technically feasible process can be developed. 6 refs., 1 fig., 2 tabs.

30220 (DOE/SF/16299—T6) Economic Decision Making Model for Geothermal Sludge Disposal alternatives (EDM-GSD): Version 1.0. (Meridian Corp., Alexandria, VA (USA)). Sep 1987. Contract AC03-86SF16299. 58p. NTIS, PC A; Order software packages from National Energy Software Center, Argonne National Laboratory, 9800 South Cass Avenue, Argonne, IL 60439. Order documentation without complete package from NTIS.; GPO Dep. Order Number DE88000277/JAW.

The Economic Decision Making Model for Geothermal Sludge Disposal Alternatives-Version 1.0" (EDM-GSD 1.0) is a microcomputer-based dynamic model developed to assist in determining the benefits and costs of various geothermal solid waste treatment procedures. It is intended for use by geothermal managers in dealing with geothermal waste and treatment process issues as a means to assist in overcoming the technical and economic barriers to expanded geothermal energy utilization. The model is based on a 50MW flash plant. However, it is designed to provide the user with sufficient flexibility when inputing data to analyze all types of geothermal plants. Default values for economic and technical parameters can be overridden by the user through the input of specific data. In addition, data can be changed for any year of an analysis to account for desired changes in input parameters such as costs and distance to disposal sites. The results of the model will allow the user to: Determine current geothermal plant disposal costs; Evaluate the cost-effectiveness of alternative treatment techniques; and Evaluate the economic effects of changes in disposal regulations.

30221 (LA—11210-PR) Water quality in the vicinity of Fenton Hill, 1985 and 1986: Progress report. Purtymun, W.D.; Ferenbaugh, R.W.; Williams, M.C.; Maes, M.N. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 37p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006496/JAW.

Water quality data have been collected since 1974 from established surface and groundwater stations at and in the vicinity of Fenton Hill (Hot Dry Rock Geothermal Demonstration Site) located in the Jemez Mountains. This is part of a continuing program of environmental studies. Data on chemical quality of water were determined for samples collected from 13 surface water and 19 groundwater stations in 1985 and 1986. There were slight variations in the chemical quality of the ground and surface water in 1985 and 1986 as compared with previous analyses; however, these variations are within normal seasonal fluctuations. Chemical uptake in soil, roots, and foliage is monitored in the canyon, which receives intermittent effluent release of water from tests in the geothermal circulation loop and occasional fluids from drilling operations. The chemical concentrations found in soil, roots, and vegetation as the result of effluent release have shown a decrease in concentration down-canyon and also have decreased in concentration with time since the larger releases that took place in the late 1970s and early 1980s. 18 refs., 7 figs., 9 tabs.

1509 Geothermal Engineering

30222 (LA-UR—88-1358) Hot dry rock fracture propagation and reservoir characterization. Murphy, H.; Fehler, M.; Robinson, B.; Tester, J.; Potter, R.; Birdsell, S. (Los Alamos National Lab., NM (USA); Massachusetts Inst. of Tech., Cambridge (USA); Mechanical Design Services, Los Alamos, NM (USA)). 1988. Contract W-7405-ENG-36. 10p. (CONF-880477—2).

From DOE geothermal program review; San Francisco, CA, USA (19 Apr 1988).

North America's largest hydraulic fracturing opeations have been conducted at Fenton hill, New mexico to creae hot dry rock geothermal reservoirs. Microearthquakes induced by these fracturing operations were measured with geophones. The large volume of rock over which the microearthquakes were distributed indicates a mechanism of hydraulic stimulation which is at odds with conventional fracturing theory, which predicts failure along a plane which is perpendicular to the least compressive earth stress. Shear slippage along pre-existing joints in the rock is more easily induced than conventional tensile failure, particularly when the difference between minimum and maximum earth stresses is large and the pre-existing joints are oriented at angles between 30 and 60{degree} to the principal earth stresses, and a low viscosity fluid like water is injected. Shear slippage results in local redistribution of stresses, which allows a branching, or dendritic, stimulation pattern to evolve, in agreement with the patterns of microearthquake locations. Field testing of HDR reservoirs at the Fenton Hill site shows that significant reservoir growth occurred as energy was extracted. Tracer, microseismic, and geochemical measurements provided the primary quantitative evidence for the increases in accessible reservoir volume and fractured rock surface area. These temporal increases indicate that augmentation of reservoir heat production capacity in hot dry rock system occurred. For future reservoir testing, Los Alamos is developing tracer techniques using reactive chemicals to track thermal fronts. Recent studies have focused on

the kinetics of hydrolysis of derivatives of bromobenzene, which can be used in reservoirs as hot as 275{degree}C.

1520 Geothermal Data And Theory

REFER ALSO TO CITATION(S) 31366

17 WIND ENERGY

30223 **(PNL-SA—15101) Overview of wind behavior research in the US Wind Energy Program.** Wendell, L.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-871062—13). NTIS, PC A; Q 02/MF A01;1; GPO Dep. Order Number DE88005683/JAW.

From Windpower '87; San Francisco, CA, USA (5 Oct 1987).

The relevant behavior presently under investigation inncludes rotor-scale turbulence and wind variability on a scale applicable to wind farms caused by terrain complexity and turbine-generated wakes in the array. Results of rotor-scale turbulence experiments have demonstrated that the spatial variation of the flow across the rotor disk is critical in the type of forcing function experienced by a rotating blade. Rotor-scale turbulence models that approximate the effect of rotational sampling with spectral information from a sigle anemometer or time series data from several levels on a single tower have been developed and tested. A self-optimizing flow model has demonstrated the capability to produce wind speed estimates over a wind farm area in complex terrain generally to within a 5% root mean square error. Wind turbine wake field experiments have shown a strong site-dependence in the factors affecting wake behavior. Work has begun in the area of combining complex terrain flow models and wind turbine array models for micrositing applications. 21 refs., 3 figs.

1704 Economics

30224 (CONF-8605117—, pp 180) **Wind power generation: observations of a privately owned facility.** Rosberg, D. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper describes the actual operating cost to install and maintain wind generators as compared to the payback in energy cost savings. It provides actual cost figures for a space heating operation using both wind generated electricity and utility company energy. The paper also gives some design criteria for setting up a wind generator to maximize the wind energy.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 30223

30225 **(SERI/STR—217-3309) Yaw dynamics of horizontal axis wind turbines: First annual report.** Xudong, C.; Hansen, A.; Siedschlag, N. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering). Feb 1988. Contract AC02-83CH10093. 104p.

Numerous problems associated with yaw exists on free-yaw and yaw-driven wind turbines. Yaw-driven machines experience failures in the yaw drive due to excessive loads, while free-yaw machines experience high yaw rates and frequent misalignment problems. This report describes a theoretical investigation of the yaw behavior of wind turbines, which was carried out by the University of Utah. The basic approach to this analysis was to develop a series of analytical and computer models such that each successive model added complexity and increased accuracy. These models are described and compared to results from other models and also to test data. Comments are made on the models' ability to predict yaw moments and response. Also, useful insight is presented regarding the free-yaw behavior of wind turbines as observed using these models. The most complex of these models is used to predict the coupled free-yaw and flap motions of a rotor. This model, "YawDyn," is operational; however, experience with it is limited. Future plans, for further enhancing and validating this model, are also discussed. 20 refs., 36 figs., 3 tabs.

20 ELECTRIC POWER ENGINEERING

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 29837, 29839, 30255, 30307, 30395, 30452, 30530

30226 **(CONF-871267—1) Competitive pricing in the electric utility industry.** Costello, K.W.;Hemphill, R.C. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 37p.

From Public utilities and transportation group session; Chicago, IL, USA (28 Dec 1987).

The seeds of competition have begun to erupt in the electric utilitiy industry. Electric utilities are entering an era in which their monopoly power is being seriously threatened from different sides. Particularly, utilities are more intensively competiting among each other and, in some cases, with independent power producers in both the wholesale and industrial markets. In addition, independent power producers have emerged as serious rivals of local utilities. State and federal public utility regulators are under pressure by market and technologial forces to alter their policies so that competition can be accommodated. The general consensus is that the electric utility industry is rapidly moving toward soem form of partial deregulation. At the minimumm, regulatory reform of the electric utility industry seems imminent over the next few years. The major challenge confronting state public utility commissions (PUCs) is to harness the emerging competitive forces so that consumers can reap a major share of the benefits over the transitional period in which electric utilities will continue to have exclusive frachises and full control over the transmission network. This paper focuses on the pricing policies of PUCs in the context of an increasingly competitive industrial market. Many electric utilities face the possibility of losing a large portion of their industrial load to alternate suppliers and technologies. "Bypass" has become a major concern of utilities and regulators. The electric utility industry is no longer immune from the bypass phenomenon that has recently erupted in the telecommunicatiosn and natural gas industries. How regulators can best cope with the prospects of bypass in the electric utility industry is the major topic of this paper. 15 refs., 2 figs., 1 tab.

30227 (CONF-8605117—, pp 101-106) **Atmospheric fluidized bed combustion: an attractive energy producing alternative for the industrial and commercial markets.** Zobeck, B.J.; Hajicek, D.R.; Mann, M.D.; Kadrmas, R.J. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Oil and gas are currently the predominant fuels for process steam generation, on site electrical generation, and direct and indirect heating requirements in the industrial, commercial, and residential markets. Atmospheric fluidized bed combustion of coal can potentially replace some of these oil and gas dominated markets. Advantages of fluidized bed combustion include: uncertainty in the future costs and availability of oil and gas, flexibility to burn a wide variety of coals or other fuels, and the ability to burn coal in an environmentally and economically acceptable manner. Current acceptance of this technology has increased to a point that approximately 100 commercial atmospheric fluidized bed boilers are either operating or on order in the US.

30228 **(EGG-M—40887) Determining system maintainability as a probability.** Wright, R.E.; Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 5p. (CONF-880692—2). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007722/JAW.

From 15. INTER-RAM conference for the electric power industry; Portland, OR, USA (14 Jun 1988).

Maintainability has often been defined in principle as the probability that a system or component can be repaired in a specific time given that it is in a failed state, but presented in practice in terms of mean-time-to-repair. In this paper, formulas are developed for maintainability as a probability, analogous to those for reliability and availability. This formulation is expressed in terms of cut sets, and leads to a natural definition of unmaintainability importance for cut sets and basic events. 6 refs.

30229 (EPRI-AP—5702) Gas turbine procurement: 1987 workshop: Final report. Sanders, C.F.;Shore, D.E. (Energy Systems Associates, Tustin, CA (USA)). Mar 1988. 295p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920242/JAW.

A workshop related to gas turbine procurement for reliability, availability, and maintainability in the electric utility industry was held in Hartford, Connecticut, on October 1-2, 1987. during the workshop, eleven presentations covered a spectrum of topics pertinent to gas-turbine specification and procurement. Included were a review of EPRI programs supporting reliability and availability, developing guidelines for procurement, customizing turbines for utility needs, utility operating experience with gas turbines, a turnkey approach to procurement, re-examining turbine specifications, a report on the repowering of Duke Power's Chesterfield 7, management considerations in turbine procurement, and control options for gas turbines. Eleven reports have been cataloged separately.

30230 (EPRI/AP/EM/EL—5470) Materials and devices for power electronic applications: Final report. Steitz, P. (Steitz and Associates, Sun Prairie, WI (USA)). Mar 1988. 94p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920244/JAW.

This report presents the results of an effort by the Electric Power Research Institute (EPRI) to (1) develop a better understanding of the interplay between power electronic equipment (applications), power semiconductor devices, and semiconductor materials; and to (2) identify critical research needs for such materials and devices. The results indicate that the field of power electronics is on the verge of having a revolutionary impact on the generation, transmission, and utilization of electric power. However, if the United States power electronic community is to play a major role in this revolution, more interaction between the applications, devices and materials sectors of this community is needed. As part of such interaction, coordinated marketing research and technology assessment efforts are needed to help focus power electronic research activities toward the development and commercialization of marketable products. There is also a need for more coordinated basic research. A number of specific device and materials related research needs and a set of followup activities to pursue the questions raised and to continue the dialogue started through this effort were identified. The implications for EPRI's program in power electronic activity are discussed.

30231 (EPRI-CS—4252-Vol.7) Dissimilar-weld failure analysis and development: Volume 7, Prediction of Damage in Service (PODIS): Code-background document: Final report. (Metal Properties Council, Inc., New York (USA)). May 1988. 132p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88010314/JAW.

This document provides the technical background for the dissimilar weld life prediction computer program PODIS (Prediction of Damage in Service). PODIS is based on a set of empirical equations relating damage to loading history for both stainless-steel and nickel-base filler metal welds. The empirical equations were derived by regression analyses using well-characterized data from in-service investigations and laboratory tests. The equations were then validated using a large number of data points, mostly from service. The load damage equations can be used to estimate the damage in welds (in-service)when the various loads on the weld have been deduced from either the past of future operating hidtory of the plant. The evaluation of the damage components from a PODIS analysis can also be used for planning corrective action (plant modification or change in operating conditions) to increase the redisual life of a weld. The analysis technique has been programmed for IBM-compatible personal computers. 19 refs., 2 figs., 4 tabs.

30232 (EPRI-CS—5517) Periodic vibration monitoring: Utility experience: Final report. Piety, K.R.; Pardue, E.F.; Cain, J.R.; Phillips, E.P.; Greene, R.H. (Computational Systems, Inc., Knoxville, TN (USA)). Mar 1988. 142p. NTIS, PC A; Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920231/JAW.

This report presents results obtained from the cumulative experience of eight utilities which are conducting periodic, computer-based predictive maintenance (PM) programs at their fossil stations. These programs are utilizing a new generation of PM instrumentation that significantly reduces the cost of conducting a program while improving fault detection effectiveness. An overview ofhow these programs are being conducted is provided in this report, along with a summary of program results being achieved and associated cost/benefit data. One utility which tracked the actual costs of the maintenance performed and carefully estimated cost savings compiled a total program savings in 1986 of over $1 million by detecting over 100 impending failures. Finally, specific recommendations are presented for monitoring boiler feed pumps by using the information extracted from the machinery databases of the participating utilities and from the collective experiences of the authors. 15 refs., 14 figs., 12 tabs.

30233 (EPRI-CS—5606) Condition monitoring of fans with rolling element bearings: Final report. Tuten, J.M.; Kurre, M.D. (Battelle Columbus Div., OH (USA)). Mar 1988. 95p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920257/JAW.

A technique to predict impending bearing failures is currently nder development. Research was conducted to detmine the current state of the art of diagnostic monitoring of axial flow fan bearings. On the basis of this knowledge, a system was designed and built to monitor and store spectrum information of the vibration levels of a number of large axial-flow fan bearings. The system was in operation collecting data for almost 3 years. Results of the background research and analyis of data collected are presented along with methods for predicting impending failure. 25 refs., 32 figs.

30234 (EPRI-CS/EL—5593-Vol.3) Life assessment methodology for turbogenerator rotors: Volume 3, SAFER [Stress and Fracture Evaluation of Rotors] code methodology tutorial for turbine rotor lifetime estimation. Somer, B. (Jones (J.A.) Applied Research Co., Charlotte, NC (USA)). Mar 1988. 345p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920255/JAW.

The Stress and Fracture Evaluation of Rotors (SAFER) computer code was developed by EPRI several year ago follwing the Gallatin rotor burst in 1974. SAFER combines the engineering disciplines of machine design, finite element stress analysis, heat transfer, non-destructive evaluation (NDE) techniques, mechanical metallurgy and fracture mechanics; this software tool provides the electric utility industry with a useful tool for an independent review and analysis of fully integral turbine-generator rotors with near bore flaws. The purpose of this SAER Tutorial is to provide the utility engineer with an overview and understanding other engineering disciplines used in the SAFER computer code and to provide several turbine-generator rotor example life assessment analyses with the appropriate input data to facilitate the technology transfer of the SAFER code to the electric utility industry. The intent of this Totorial is not to train utility engineers to become turbine-generator rotor designers, but rather to provide them with enough information to make independent analyses to check and unerstand the OEM's recommendations and to schedule maintenance and inspection outages. This SAFER Tutorial is composed of two volumes. This voluem describes the various data input and computer output in detail with the physcial meaning of the data, while the Appendices described each rotor life assessment with an explanation of the analysis recommendations. 53 figs., 40 tabs.

30235 (ORNL/TM—10489) Assessment of material requirements for advanced steam cycle systems (>1100{degrees}F). DiStefano, J.R.; DeVan, J.H.; Fuller, L.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p.

Thermal efficiencies of coal-fired electric-generating plants generally peaked in the 1960s and have declined since that period. Because of low costs and high demand in the 1960s, utilities had little incentive to conduct the R and D needed for plants that provided improved performance. However, this situation has changed dramatically since the 1970, and emphasis is now on improving the efficiency of existing plants and designing smaller, more flexible, less costly plants for the new capacity that will be required. While several options for burning coal show good promise for the future, it remains likely that new capacity will be pulverized-coal plants for the remainder of this century. This study was performed to identify areas in which appropriate materials developments would provide the advancements needed to facilitate acceptance of higher temperature and pressure, supercritical steam cycle plants that meet modern day utilities' requirements. For advanced plants that will operate beyond 1100{degree}F/4500 psig steam conditions, new materials technologies will likely be required. The major materials problems in advanced plants are reviewed, and a spectrum of materials that might be considered are discussed. Engineering requirements and economic considerations are presented that consider the effects of higher steam temperatures and pressures on plant efficiency, fuel cost savings, and the design and economics of major plant components.

30236 Boiler tube failures in fossil power plants: Conference proceedings. Dooley, B.; Broske, D. (eds.). Palo Alto; Electric Power Research Institute, Inc. (1988). 807p. (CONF-8711170—). Research Reports Center, Box 50490, Palo Alto, CA 94303.

From Conference on boiler tube failures in fossil plants; Atlanta, GA, USA (10 Nov 1987).

A conference on boiler tube failures in fossil plants was conducted on November 10-12, 1987 at the Waverly Hotel in Atlanta, Georgia. Approximately 270 participants represented domestic and foreign utilities, equipment vendors, contractors and consultants. The objectives of the conference were to review, document and transfer technology on all aspects of boiler tube failures (BTF). To meet these objectives, papers and presentations were provided on the following topics: general topics on BTF including statistics from utilities around the world; BTF mechanisms including fatigue, fireside and waterside; remaining life assessment; BTF reduction programs; and, NDE and monitoring. Each topic discussed in a separate conference session. To maximize the information transfer, the sessions on remaining life and NDE included overviews of the topics by recognized experts in the fields (rapporteurs) as well as presentations by the authors. Discussion followed each paper and each session. These are included in the proceedings. Papers in this volume are indexed separately.

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REFER ALSO TO CITATION(S) 29833, 29837, 29839, 29889, 29891, 29892, 29895, 30444, 31093, 31113

30237 (CONF-8605117—, pp 132-137) Chemical characterization of electrostatic precipitator ashes from pressurized hydrated-lime injection tests. Henke, K.R.; Moretti, C.J. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Precipitator ashes were collected from four pressure hydrated-lime injection tests at the Hoot Lake utility plant in Minnesota. The commercial feasibility of pressure-hydrated lime SO_2 control processes will partially depend on the chemistries of the solid wastes and their disposal requirements. The chemistries of the four precipitator ashes were determined by X-ray fluorescence, X-ray diffraction, and aqueous leaching tests. None of the EP or ASTM batch leachates exceeded RCRA standards; however, once sodium sulfate washed out of the columns, barium concentrations in the column leachates increased significantly. Abundant soluble sulfate maintains low barium concentrations in the batch leachates. Most of the barium in the bulk ashes exists as water-soluble barium chloride or other phases. Calcium compounds in the precipitator ashes may reduce arsenic and boron concentrations in the alkaline leachates. The high concentrations of barium in some of the column leachates were not predicted by batch leaching, and is an example of the ability of column leaching to provide complementary data to batch leaching results.

30238 (DOE/EA—0286) Proposed transmission rate adjustment: Colorado River Storage Project: Environmental assessment. (USDOE Western Area Power Administration, Washington, DC). Jan 1986. 24p.

The Western Area Power Administration (Western) proposes to increase the firm and nonfirm rate charged for transmission of electricity over the Colorado River Storage Project (CRSP) transmission system. Notification of this intent was published in the Federal Register on October 22, 1985. The proposed adjustments would increase the firm transmission rate from the present $10.27 to $15.94 per kilowatt-year (kW-year) and nonfirm transmission rate from the present 2.0 to 3.1 mills per kilowatthour (kWh). The adjustment results in a less than one percent change in annual revenues and is therefore a minor rate adjustment as defined by current procedures for public participation in rate adjustment actions (10 CFR Part 903). In compliance with the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (November 1978), Western has prepared this environmental assessment (EA) to analyze the potential environmental and social impacts of the proposed rate adjustments.

30239 (PB—88-172937/XAB) Formation of NO_2 in power-plant plumes: measurements and modelling. Janssen, L.H.J.M.; Elshout, A.J. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1987. 26p. NTIS, PC E03/MF A01.

Pub. in Kema Scientific and Technical Reports, Vol. 5, No. 10, 259-279(1987).

Nitrogen oxides are air pollutants involved in both acid deposition of e.g., HNO_3 and formation of photochemical oxidants, e.g. ozone and peroxy acetyl nitrate (PAN). Conventional power plants are important sources of NO. After emission, NO is oxidized by ozone into NO_2 during dispersion of the flue-gas plume in the atmosphere. Modelling of the fairly rapid conversion process is hampered by the interaction of the mixing process and the chemical kinetics. The contribution concerns the formation of nitrous oxide in power-plant plumes and the evaluation of field measurements by means of a gaussian-type reactive plume model. The model assumes homogeneous mixing and photostationary equilibrium in the plume. The results showed that the NO_2/NOx ratio can be calculated within the limits of reliability in many cases. A box-type model that incorporates inhomogeneous mixing was used to model the measured deviations of photostationary equilibrium in the plume. Measured deviations of the equilibrium can be explained by two causes, i.e., the various time rates at which the physical processes of dispersion and mixing, and the chemical processes of molecular reactions occur, and an extra contribution of ozone in parcels of unmixed ambient air in the plume.

30240 (PB—88-185236/XAB) Lignosulfonate-modified calcium hydroxide for sulfur dioxide control. Kirchgessner, D.A.; Lorrain, J.M. (Acurex Corp., Research Triangle Park, NC (USA)). 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Industrial and Engineering Chemistry Research, Vol. 26, No. 11, 2397-2400(1987).

This article discusses the use of lignosulfonate-modified calcium hydroxide $Ca(OH)_2$ for sulfur dioxide (SO_2) control. The limestone injection multistage burner (LIMB) process is currently being developed at the U.S. EPA as a low cost retrofittable technology for controlling oxides of sulfur and nitrogen from coal-burning utility boilers. The most effective commercial calcium-based sorbent for this process is $Ca(OH)_2$, with SO_2 removals of about 50%. Additions of calcium lignosulfonate up to 1.5 mass % of the dry product, introduced with the water of hydration, increase the SO_2 capture of the resulting $Ca(OH)_2$ to 60%. This is achieved

through particle-size reduction in the modified hydroxides. The principal mechanism of size reduction appears to be deagglomeration of the $Ca(OH)_2$ crystals; a secondary benefit is derived from crystal size reduction.

30241 **(PB—88-185491/XAB) Pore-distribution changes of calcium-based sorbents reacting with sulfur dioxide.** Gullett, B.K.; Bruce, K.R. (Acurex Corp., Research Triangle Park, NC (USA)). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in AIChE Jnl., Vol. 33, No. 10, 1719-1726(Oct 1987).

This paper gives results of a determination of changes in the pore structure of calcium oxide sorbents derived from calcium carbonate (termed c-CaO) and calcium hydroxide (termed h-CaO) reacting with sulfur dioxide (SO_2). Results show that the pore shape of c-CaO approximates a cylinder, while that of h-CaO appears to be slit or plate-like. The pore volume of c-CaO is located in much smaller pores than that of h-CaO when compared on the basis of an equivalent geometric model. The effect of sintering was to reduce surface area through coalescence of smaller pores, while only minor effects were observed upon pore volume and conversion from CaO to calcium sulfate ($CaSO_4$). Both sorbents expand to allow greater reaction than is possible given the initial porosity and formation of a larger-volume product.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 30238, 30898, 31093

30242 **(EPRI-EL—5643) Fault location for transmission-type cables: Final report, April 1988.** Gallagher, H.E.; Dickerson, A.F. (Electric Power Research Inst., Palo Alto, CA (USA). Electrical Systems Div.). Apr 1988. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920270/JAW.

The objective of this project is to develop a fault location system for transmission-type cable. The fault locator measures the distance from the cable terminal (pothead) to the fault as a fraction of the total cable length. A forward wave radar principle is used. Two of the cables of a faulted three-phase system are used in the measurements. The faulted cable and an unfaulted cable are connected together at the far terminals, and the fault locator is connected to the near terminals. The forward waves are then generated by voltage breakdowns at the near cable terminal and at the cable fault. On the first measurement, the spark gap (connected at the near terminal) arcs and the total travel time for the forward wave is measured as it traverses down the unfaulted cable and back along the faulted cable. On the second measurement, the spark gap is removed and the voltage is increased until the cable fault arcs and two forward waves are generated at the fault. One forward wave travels along the faulted cable directly to the near terminal and the other travels to the far terminal and back along the unfaulted cable to the near terminal. The difference between these travel times is recorded. The ratio of the difference to the total travel time is used to calculate the fault location. 5 refs., 50 figs.

30243 **(ORNL/Sub—81-95011/4) Harmonic considerations for electrical distribution feeders.** (Cooper Industries, Inc., Canonsburg, PA (USA). McGraw-Edison Power Systems Div.). Mar 1988. Contract AC05-84OR21400. 147p. NTIS, PC A; 08/MF A01; GPO Dep. Order Number DE88007849/JAW.

Harmonics on the electric power distribution system can cause motor overheating, capacitor failures, watthour meter error, and relay malfunctions. The degree of problems caused by harmonics is greatly dependent on the characteristics of the distribution feeder. A typical distribution feeder can absorb a considerable percentage of its capacity in harmonic currents without ill effects. However, power factor correction capacitors can cause resonances near harmonic voltages that can result in intolerable distortion. Both motor loads and resistive loads can decrease the effet of resonance significatnly. This report describes useful techniques to analyze, suppress, and measure harmonics on distribution feeders. Applicable areas for manual analysis and computer analysis are explained. The basic formulae are presented as well as sophisticated omputer methods. Emphasis is placed on the fundamental principle. Models of harmonic-producing devices are presented and their limitations discussed. Most distribution feeder harmonics analyses can be performed using simple current source models. Filtering of specific loads and general, dispersed load is discussed. The fundamental principle in filtering distribution feeders is to shorten the harmonic current path. 3-dimensional plots enhance the understanding of the filtering action. Equipment and procedures for making measurements are described.

30244 **(ORNL/Sub—84-89650/1) Voltages induced by lightning on electric power distribution lines: Field data and analysis results for the period July 1984-1986.** Thomson, E.M. (Florida Univ., Gainesville (USA). Dept. of Electrical Engineering). Mar 1988. Contract AC05-84OR21400. 58p.

Measurements have been made during 1984 and 1985 at the NASA Kennedy Space Center, Florida using a newly-developed spherical antenna of the time-domain horizontal and vertical electric fields from lightning return strokes. Statistics are presented for the fields of 42 return strokes. The peak horizontal field was about 0.03 of the peak critical field; the horizontal field had a mean risetime and a falltime to half value about 0.3 μs prior to the peak in the vertical field. Voltage has also been measured at one end of an unenergized power distribution line about 500 m in length and 10 m in height. Tables of measured peak voltages are given. By way of a newly-written computer program, the line voltage has been calculated using the measured fields as inputs. Agreement between the voltage measurement and theory is generally good. The lightning horizontal electric field can significantly contribute to the induced line voltage. The horizontal fields become larger as the earth conductivity decreases. 16 figs., 3 tabs.

30245 **(PB—88-172945/XAB) Optical sensors for the measurement of electric current and voltage.** Rutgers, W.R.; Hulshof, H.J.M.; Laurensse, I.J.; van der Wey, A.H. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1987. 17p. NTIS, PC E03/MF A01.

Pub. in Kema Scientific and Technical Reports, Vol. 5, No. 11, 281-292(1987).

Optical sensors for the measurement of electrical current and voltage were developed for application in electric power systems. The current sensor, based on the Faraday effect in a monomode glass fiber, and the voltage sensor, based on the transverse Pockels effect in a crystal, are demonstrated in wide-band (10 MHz) interference-free measurements of pulsed currents and impulse voltages.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 30304, 31975

30246 **(EGG-M—22887) Status of the RELAP5 user guidelines.** Jacobson, J.L.; Hanson, R.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-8710111—46).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

This paper presents an overview of a RELAP5 User Guidelines document which is currently being developed under the sponsorship of the US Nuclear Regulatory Commission (USNRC) at the Idaho National Engineering Laboratory (INEL). The RELAP5 User Guidelien will provide insight for proper code use for specific applications and specific guidance relative to nodalization of nuclear power plants and experimental facilities based on a standard nodalization philosophy. 33 refs.

30247 **(IAEA-TECDOC—443) Experience with simulator training for emergency conditions. Report of a technical committee meeting held in Vienna, 15-19 September 1986.** (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 209p. (CONF-8609420—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW.

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The training of operators by the use of simulators is common to most countries with nuclear power plants. Simulator training programmes are generally well developed, but their value can be

limited by the age, type, size and capability of the simulator. Within these limits, most full scope simulators have a capability of training operators for a range of design basis accidents. It is recognized that human performance under accident conditions is difficult to predict or analyse, particularly in the area of severe accidents. These are rare events and by their very nature, unpredictable. Of importance, therefore, is to investigate the training of operators for severe accident conditions, and to examine ways in which simulators may be used in this task. The International Nuclear Safety Advisory Group (INSAG) has reviewed this field and the associated elements of human behaviour. It has recommended that activities are concentrated on this area. Initially it is encouraging the following objectives: i) To train operators for accident conditions including severe accidents and to strongly encourage the development and use of simulators for this purpose; ii) To improve the man-machine interface by the use of computer aids to the operator; iii) To develop human performance requirements for plant operating staff. As part of this work, the IAEA convened a technical committee on 15-19 September 1986 to review the experience with simulator training for emergency conditions, to review simulator modelling for severe accident training, to examine the role of human cognitive behaviour modelling, and to review guidance on accident scenarios. A substantial deviation may be a major fuel failure, a Loss of Coolant Accident (LOCA), etc. Examples of engineered safety features are: an Emergency Core Cooling System (ECCS), and Containment Systems. This report was prepared by the participants during the meeting and reviewed further in a Consultant's Meeting.

30248 (IAEA-TECDOC—443, pp 93-105) **Improving error feedback to trainees during nuclear power plant simulator training.** Lucas, D.A.; Embrey, D.E. (Human Reliability Associates Ltd., Parbold, Lancashire (UK)). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The paper discusses possible ways of providing the trainer at a nuclear power plant training simulator with the necessary information to provide feedback for the two major types of human error, that is: errors of intention where incorrect actions are taken because the operator has incorrectly diagnosed the situation or has chosen an inappropriate procedure; and errors of execution where the diagnosis is correct but a slip has occurred in carrying out the planned actions. The paper also describes a method for identifying an operator's knowledge of the particular accident sequence that is being used for simulator training. Ideally the knowledge of each operator should be checked for any potential problems and to do this some method for eliciting his internal mental model is required. The paper also describes a computer based technique called IMAS (Influence Modelling and Assessment System) which has been developed to elicit an operator's understanding of the dynamics of the accident sequence. This method potentially allows any major deficiences in the understanding of the operator to be determined. Knowledge of these deficiences would allow appropriate remedial training to be applied. (author). 12 refs, 2 figs, 3 tabs.

30249 (IAEA-TECDOC—443, pp 157-163) **Upgrading simulator software to improve response for emergency training.** Saphier, D. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The limitations of some of the older simulators used today for operator training are presented. The requirements for an advanced simulator for operator emergency training are outlined. A method to upgrade and test the simulator software is presented. This method uses a special purpose simulation language by which both the simulator and the plant can be simulated, verified and upgraded. (author). 5 refs, 1 fig.

30250 (IAEA-TECDOC—443, pp 201-206) **Critical analysis of simulator use in nuclear power plant operator training.** Zanobetti, D. (Bologna Univ. (Italy). Inst. of Industrial Electrical Engineering). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

Operator training on simulators is carried out first on basic-principle simulators, followed by training on full-scope reference plant simulators. Retraining makes mainly use of the full-scope facility. On-site, part-task simulators or analyzers are available providing a convenient way of exercising operations which are not frequent in practice or permit rehearsal of difficult or unusual operations before applying them in practice. The malfunctions covered during training should primarily be chosen for their training value, i.e. their effectiveness in developing diagnostic abilities. Furthermore the advantages and disadvantages of training centres versus site specific simulators are discussed. Finally, the importance of proper assessment of operator's performance and of adequate capabilities of instructors is stressed. (author). 1 fig.

30251 **(INIS-mf—11180) Mathematical model for analysis of the nuclear power development in Bulgaria.** Pavlov, V.; Pynevski, I.; Kalchev, B. (Energoproekt, Sofia (Bulgaria)). 1984. 7p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702359/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A linear mathematical model for optimizing of the nuclear power development in Bulgaria is described. The model incorporates two indenpendent to some extent parts: electric power generation and district heating. These are connected by the electric power generated, the nuclear fuel and the combiened electric and thermal power generation. The objective function is stated as minimization of the discount costs for every period of the forecasting interval.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 30155, 30272, 30301, 30331, 30350, 30351, 30352, 30353, 30354, 30358, 30359, 30364, 30374, 30375, 30378, 30380, 30382, 30383, 30557

30252 **(AEEW-R—2211) Beginner's guide to the use of WIMS.** Halsall, M.J. (UKAEA Atomic Energy Establishment, Winfrith). Apr 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752742/JAW.

The WIMS codes are widely used for calculating the characteristics of thermal reactor lattices. WIMSD has changed little since the 1960s and is most useful for pincell and cluster calculations, WIMS-E is a modular scheme with more flexibility, and LWRWIMS is specifically for PWR and BWR assembly representations. This report provides a brief introductory guide for inexperienced users of the WIMS codes. There is an introductory part to explain why and when to use WIMS, with particular reference to the advantages of deterministic methods over stochastic (Monte Carlo) methods. A few comments on which version to use are then followed by a summary of commonly used options with examples. References are given to more complete documentation describing the input in greater detail; users are expected to move on to this as they gain experience.

30253 **(DOE/EIA—0511) An analysis of nuclear power plant operating costs.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 16 Mar 1988. 89p.

This report presents the results of a statistical analysis of nonfuel operating costs for nuclear power plants. Most studies of the economic costs of nuclear power have focused on the rapid escalation in the cost of constructing a nuclear power plant. The present analysis found that there has also been substantial escalation in real (inflation-adjusted) nonfuel operating costs. It is important to

determine the factors contributing to the escalation in operating costs, not only to understand what has occurred but also to gain insights about future trends in operating costs. There are two types of nonfuel operating costs. The first is routine operating and maintenance expenditures (O and M costs), and the second is large postoperational capital expenditures, or what is typically called "capital additions." O and M costs consist mainly of expenditures on labor, and according to one recently completed study, the majoriy of employees at a nuclear power plant perform maintenance activities. It is generally thought that capital additions costs consist of large maintenance expenditures needed to keep the plants operational, and to make plant modifications (backfits) required by the Nuclear Regulatory Commission (NRC). Many discussions of nuclear power plant operating costs have not considered these capital additions costs, and a major finding of the present study is that these costs are substantial. The objective of this study was to determine why nonfuel operating costs have increased over the past decade. The statistical analysis examined a number of factors that have influenced the escalation in real nonfuel operating costs and these are discussed in this report. 4 figs, 19 tabs.

30254 **(EGG-M—15187) Residual life assessment of light water reactor pressure vessels.** Shah, V.N.; Server, W.L.; Odette, G.R.; Swaroop, A.V. (EG and G Idaho, Inc., Idaho Falls (USA); Cloud (Robert L.) and Associates, Inc., Berkeley, CA (USA); California Univ., Santa Barbara (USA)). 1987. Contract AC07-76ID01570. 35p. (CONF-8705275—1).

From Embrittlement of reactor pressure vessel steels symposium; Philadelphia, PA, USA (27 May 1987).

The service-dependent degradation (agina) of light water reactor (LWR) pressure vessels due to irradiation embrittlement is discussed in this paper. The major variable which influence the irradiation embrittlement of LWR vessels are the copper and nickel content of the vessel materials and the fluence. The vessel beltline region is subjected to the largest fluences. A surveillance program, which consists of tensile and Charpy-V-notch (CVN) testing of irradiated specimens of base, heat-affected-zone, and weld materials, is required to monitor changes in their embrittlement. Three main unresolved technical issues are: the limited range and accuracy of the current correlations for caluclating shifts in the reference temperature for nil-ductility transition (RT/sub NDT/) and changes in the Charpy upper shelf energy: the need to demonstrate the conservatism of using CVN-based RT/sub NDT/ shifts for certain sensitive reactor pressure vessel materials; and the type of surveillance program required for any renewed operating license period. The damage caused by irradiation embrittlement can impact plant operating procedures, including heatupcooldown and hydrostatic test procedures, as well as the acceptability of various plant transients. 23 refs., 3 figs., 1 tab.

30255 **(EPRI-CS—5486) Nonradioactive tracer for steam turbine thermal performance tests: Final report.** Irwin, P.C. (General Electric Co., Schenectady, NY (USA). Turbine Technology Dept.). Mar 1988. 90p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920226/JAW.

In the past expensive measuring devices were used to determine performance cycle performance and efficiency of nuclear turbines and their components. The sodium-24 nitrate tracer technique replaced these devices because of its lower cost, increased accuracy, and improved precision. While having advantages over the radioactive tracer such as less cost and greater simplicity, the nonradioactive replacement theoretically is not as sensitive as the sodium-24 technique. This report discusses the criteria used for choosing the replacement tracer, the unique means of concentrating the tracer prior to analysis, the necessary refinements to the sodium-24 testing procedure, and the result of the field tests. The laboratory experiments and simulated field tests indicated high promise for success in actual trails. In 1984, the nonradioactive tracer was compared to conventional methods in a fossil-fired plant;a comparison of the non-radioactive tracer and sodium-24 in a nuclear power plant was completed in late 1985. The uses for the new technique are also discussed.

30256 (IAEA-TECDOC—443, pp 193-200) **BWR operator training for emergency conditions using simulator in Japan.** Kobayashi, A.; Morioka, T.; Satoh, T. (BWR Operator Training Center Corp., Fukushima (Japan); Toshiba Corp., Tokyo (Japan); Hitachi Ltd., Tokyo (Japan)). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

BWR Operator Training Center Corporation (BTC) is the only training organization for all Japanese BWR utilities. BWR operator training program is constructed to maintain and upgrade the ability of the individual operator and the operation crews. The training course for the individual operator is focused on the operator's positions, from that of the main operator to the licensed shift supervisor. The target of the training for operation crews, which is called the family training, is to upgrade the team performance including shift supervisor. The training programs are combined to improve and upgrade the operator performance using simulator. BWR training simulator has been designed to demonstrate many kinds of malfunctions, modeling a single failure and multiple failure, including loss of coolant accident. It has also the alteration and scheduling function to simulate the abnormal and accident situation. These functions are utilized to easily simulate the accident scenario and enlarge the operator's knowledge in case of the abnormal condition. This paper describes the BWR operator training for emergency conditions using simulator and the advanced control board simulator performance including the abnormal situation functions. (author). 5 refs, 2 tabs.

30257 **(INIS-mf—11185) Operating trends and performance of nuclear power plants in IAEA member states.** Galori, F. (Energoproekt, Sofia (Bulgaria)). 1984. 35p. (CONF-8405447—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702364/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The present status and short-term development of nuclear power programmes in IAEA member states is reviewed. A description of the IAEA Power Reactor Information System (PRIS) is given and the objectives for data collection and treatment are discussed. As indicated by the reports at the IAEA International Conference on Nuclear Power experience in 1982, there are considerable differences in the performances of nuclear power plants even within classes of plants which technically should be very similar and thus perform equally well. PRIS permist at least some preliminary conclusions about the reasons for differences to be drawn. It is becoming clear that reasons for good or bad performance must be sought in a number of factors including: type of plant (on-load/off-load refuelling, GCR, PHWR, LWR); age and vintage of plant; manufacturer of the main plant system; degree of standardization in plant and construction; competence of operating organization; regulatory climate. Analysis of the reported outages shows that major problems are: stress corrosion cracking in primary piping, also denting and wall thinning in tubes of steam generators; thermal fatigue cracking in the feedwater system and excessive errosion/corrosion problems in turbines. It is emphasized that international cooperation is important for creating an effective system for learning from operating experience.

30258 **(NUREG/CR—3950-Vol.4) Fuel performance annual report for 1986.** Bailey, W.J.; Wu, S. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering and System Technology). Mar 1988. Contract AC06-76RL01830. 180p. (PNL—5210-Vol.4).

This annual report, the ninth in a series, provides a brief description of fuel performance during 1986 in commercial nuclear power plants and an indication of trends. Brief summaries of fuel design changes, fuel surveillance programs, fuel operating experience, fuel problems, high-burnup fuel experience, and items of general significance are provided. References to more detailed information and related U.S. Nuclear Regulatory Commission evaluations are included. 550 refs., 12 figs., 31 tabs.

30259 (NUREG/CR—4860-Rev.1) **Flaw density examinations of a clad boiling water reactor pressure vessel segment.** Cook, K.V.; McClung, R.W. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 21p. (ORNL/TM—10364/R1).

As part of the Oak Ridge National Laboratory's Heavy-Section Steel Technology Program, studies have been conducted to determine flaw density in a section of reactor pressure vessel cut from the Hope Creek Unit 2 vessel. This boiling water reactor vessel was never in service. One objective was to evaluate the approximate 0.7- by 3-m (2- by 10-ft) segment of the vessel provided using ultrasonic flaw detection methods peformed with both ASME Code techniques and supplemental ultrasonic methods. A second objective was to evaluate the inner surface stainless steel cladding for cracks with a high sensitivity penetrant examination. Both objectives were successfully completed. Five Code-recordable indications were detected ultrasonically; however, all were found to be anomalies associated with the cladding. One flaw was detected by the supplemental ultrasonic tests, and it was analyzed destructively. This flaw was a pipelike indication, about 20 mm (0.8 in.) long extending along the length of the longitudinal weld in which it was located and was about 20 mm below the cladding surface. The flaw had a through-wall dimension (or length) of about 6 mm (0.24 in.) for an approximate 3-mm (0.1-in.) distance along the 20-mm major length. No flaws were detected by the penetrant examination of the cladding surface.

30260 (SAND—87-2572C) **Testing of a 1:6-scale concrete containment model: Instrumentation, data acquisition, and pressure control.** Lambert, L.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 22p. (CONF-880548—1).

From 34. international instrumentation symposium; Albuquerque, NM, USA (1 May 1988).

A 1:6-scale model of a reactor containment building was tested by Sandia National Laboratories (Sandia) as part of an NRC-sponsored program whose objective is to qualify methods for predicting the response of light water reactor containment buildings subjected to severe accidents. This model was designed and built to the American Society of Mechanical Engineers (ASME) code by United Engineers and Constructors, Inc. It had several features representative of a prototypical reinforced containment, including equipment hatches, personnel airlocks, several small piping penetrations, and a steel liner. This was the largest and most heavily instrumented containment model ever tested. Over 1200 channels of instrumentation were utilized to assess the model's behavior during testing. The final test was conducted continuously for approximately 32 hours, during which time the model was pressurized with nitrogen gas to its ultimate capacity. The pressure control system was used to pressurize the model in steps and after each step the transducers were scanned to record the model's response. This paper decribes the conduct and outcome of the test as well as the instumentation that was used to obtain the test data. The selection, installation, protection, and performance of the instrumentation are discussed. The data acquisition and pressure control systems are also described.

30261 (TPR-NS—29-No.1, pp 58-63) **Evaluation of nonradiological water chemistry at power reactors.** Zibulsky, H.; Kottan, J.J.; Pasciak, W.J.; Castrogivanni, M.A.; Banerjee, S. (Nuclear Regulatory Commission, Washington, DC (USA)). 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

A two-phase inspection program for the evaluation of nonradiological water chemistry programs at power reactors is described. Phase I appraisal is concerned with organization, staffing, training, quality assurance and quality control practices, and the appropriateness of analytical procedures. In phase II, laboratory proficiency is assessed through use of certified test standards. The data for phase II are compiled for the facilities in US NRC Region 1 and are statistically evaluated. Generic problems and areas of concern are discussed.

30262 (TPR-NS—29-No.1, pp 64-66) **Reactor shutdown experience.** Cletcher, J.W. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

This section presents a regular report of summary statistics relating to recent reactor shutdown experience. The information includes both numbers of events and rates of occurrence. It was compiled from data about operating events entered into the SCSS data system by the Nuclear Operations Analysis Center at the Oak Ridge National Laboratory, covering the three-month period of July, August, and September 1987. Cumulative information, since May 1, 1984, is also shown. Updates on shutdown events included in earth reports are excluded. Table 1 lists information on shutdowns as a function of reactor power at the time of the shutdown for both boiling-water reactors (BWRs) and pressurized-water reactors (PWRs). Table 2 shows data on shutdowns by shutdown type: Real Scrams are events in which the reactor was scrammed for a valid cause; Spurious Scrams are events in which an instrument failure of other fault causes a scram not actually called for by existing reactor conditions; Non-Scram shutdowns (frequently from operating power to hot standby) do not involve actuation of the scram system, either manually or automatically. Only reactors in commercial operation are included. Table 3 lists information about shutdowns by reactor age category, both total numbers and rates in that category; it also shows cumulative results.

30263 (TPR-NS—29-No.1, pp 100-102) **Status of power reactor projects undergoing licensing review.** Silver, E.G. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

Recent regulatory and other actions relating to US power reactors undergoing steps toward licensing are summarized in Table 1 for the third quarter of 1987. This section also contains a brief report of fuel loading and low-power testing authorized for South Texas Project 1. This license was the 108th issued by the NRC for a nuclear power plant. South Texas 1 is a 250 MW(e) Westinghouse pressurized-water reactor, one of two identical plants at the same facility; Unit 2 is about 80% complete and is expected to be in commercial operation in 1989.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 30155, 30253, 30254, 30255, 30257, 30258, 30260, 30261, 30262, 30263, 30301, 30312, 30313, 30314, 30318, 30332, 30333, 30334, 30335, 30336, 30337, 30338, 30339, 30340, 30341, 30345, 30346, 30347, 30348, 30350, 30352, 30353, 30358, 30359, 30360, 30361, 30364, 30365, 30371, 30376, 30378, 30380, 30382, 30383, 30557, 30751, 32042

30264 (AEEW-R—2044) **Application of liquid chromatography techniques to the measurement of soluble transition metals in PWR primary coolant.** Amey, M.D.H.; Brown, G.R. (UKAEA Atomic Energy Establishment, Winfrith). Jan 1987. 44p. (PWR-CWG-P—86-365). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752732/JAW.

Two chromatographic techniques have been developed, and evaluated for the on-line analysis of soluble transition metals, particularly cobalt, in PWR primary coolant. Automatic operation and control, together with data processing and storage has been achieved by interfacing a Dionex ion chromatograph to a microprocessor control system. An absolute detection limit of 0.1 ng cobalt has been obtained which, with on-line sample preconcentration (100 ml), has enabled measurements to be made down to part-per-trillion levels (0.001 ppb). Application of the techniques to PWR coolant analysis was demonstrated by a programme of work on the Half Megawatt Loop at Winfrith. During this work some aspects of the behaviour of soluble metal species have been studied in both de-oxygenated and hydrogenated conditions. The effects of changes in coolant chemistry, operating temperature, and sample line flowrates on circulating impurity levels are reported, together with the dramatic effects observed when part of the circuit pipework was replaced with new stainless steel tubing.

30265 **(AEEW-R—2050) Experimental and analytical study of fluid flow and critical heat flux in PWR fuel elements.** Bowditch, F.H.; Mogford, D.J. (UKAEA Atomic Energy Establishment, Winfrith). Feb 1987. 131p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752734/JAW.

This report describes experiments that have been carried out at the Winfrith Establishment of the United Kingdom Atomic Energy Authority to determine the critical heat flux characteristics of pressurized water reactor fuel elements over an unusually wide range of coolant flow conditions that are relevant to both normal and fault conditions of reactor operation. The experiments were carried out in the TITAN loop using an electrically heated bundle of 25 rods of 9.5 mm diameter on a 12.7 mm pitch fitted with plain grids in order to provide a generic base for code validation. The fully tabulated experimental data for critical heat flux, pressure drop and sub-channel mixing are encompassed by ranges of pressure between 20 and 160 Bar, coolant flow between 150 and 3600 Kgm^2s, and coolant inlet temperature between 150 and 320°C. The results of the experiments are compared with predicted data based upon several established critical heat flux correlations. It is concluded that the extrapolation of some correlations to conditions beyond their intended range of application can lead to dangerous over estimates of critical heat flux, but the Winfrith WSC-2 and the EPRI NP-2609 correlations perform well over the whole data range and correlate all data with RMS errors of 9% and 6% respectively.

30266 **(AEEW-R—2089) Actinide levels measured in the primary coolant of Belgian PWRs.** Symons, W.J.; Amey, M.D.H.; Cox, W.R. (UKAEA Atomic Energy Establishment, Winfrith). Aug 1986. 23p. (PWR-CWG-P—86-405). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752735/JAW.

Selected filter membranes taken during sampling campaigns on the pressurised water reactors at Doel and Tihange in Belgium have been examined in an attempt to increase the actinide data base in PWR primary coolant during normal operations and transients. Alpha spectrometry has been used to identify the radioactive nuclides present in the samples. Circulating values during normal operation, both for systems with and without failed fuel, and for shutdown sequences, are reported. The results support the suitability of cerium-144 as an indirect monitor for plutonium.

30267 **(CEA-DAS—390) Probabilistic evaluation of multiple failures for steam generators tubes by common mode.** Bloch, M.; Pierrey, J.L.; Dussarte, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 12p. (In French). (CONF-870820—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753045/JAW.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

The reactor safety can be affected when systems or components are subject to phenomena conducting at a wear nontake in account in the conception. This paper presents a methodology which takes in account the non simultaneous failures resulting of this situation. To illustrate this purpose, we give an evaluation of risk of multiple failures for steam generators tubes by common mode (stress corrosion) when the reactor is in normal operation.

30268 **(FRADOC—13-5) Devices for investigation and intervention on steam generators tubes bundles.** Launay, J.P.; Sort, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). 1986. 25p. (In French). (CONF-8610406—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753068/JAW.

From 5. day's study on pressure vessels; Paris, France (22 Oct 1986).

After a brief recall on the French regulation concerning pressure vessels, the authors describe the experience and the devices used by Framatome for closing, repairing, sleeving and shot peening for steam generators tubes bundles.

30269 (IAEA-TECDOC—443, pp 69-92) **Simulator training for emergency conditions: EDF's PWR experience, examples of scenarios.** Depond, D. (Electricite de France, 75 - Paris). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The various courses and tests provided to operators for training on severe accidental conditions are presented. Two types of training are distinguished, namely a preliminary phase where training on full-scope simulators is intended to help comprehension and to familiarize operators with the utilization of emergency operating procedures of the respective event type. The second phase in form of refresher courses is designed to enable the operator to maintain and complete his knowledge. During this type of course the operators learn how to control accidental situations which can be very complex (multiple failures) and downgraded as regards physical states (core melt down hazards). The type of simulator used to create these situations is described next, followed by several examples of the scenarios reflecting accident control conditions. (author). 5 refs.

30270 (IAEA-TECDOC—443, pp 143-155) **Training simulator for PWR nuclear power plant in Japan.** Masuda, Y.; Wakabayashi, S.; Sasaki, K. (Mitsubishi Electric Corp., Kobe (Japan). Kobe Works). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The configuration of training simulators for PWR nuclear power plant operators is presented, consisting of a full replica simulator and a basic principle compact simulator. Their outline and characteristics are given in detail. The paper then describes the primary system model which is actually divided in two parts: the dynamic and the control models. Through the dynamic models 11 systems are simulated which are operated in the central control room. The training and retraining of staff is carried out at a Nuclear Training Center and includes beginners as well as senior staff. (author). 4 figs, 1 tab.

30271 (IAEA-TECDOC—443, pp 165-179) **Experience from the use of the Loviisa nuclear plant simulator for emergency conditions training and research.** Haapanen, P.; Sammatti, P. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland); Imatran Voima Oy, Loviisa (Finland)). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The full-scope training simulator (LOKS) for the Loviisa nuclear power plant was taken into operation 1st October, 1980, and has since then been used for the training of the control room operators of the two unit power plant (VVER-440, PWR). According to a co-operation agreement between the owner of the simulator, Imatran Voima Co (IVO), and the Technical Research Centre of Finland (VTT), the simulator is used for research purposes, and VTT also takes part in the development of the models to improve the simulator capabilities. The simulator training is divided into two basically different entities; occasionally given initial training for the new operator candidates and continuous annual retraining for the existing operating crews. Retraining is given to each of the twelve crews for a total of two weeks per year. In the initial training the main emphasis is on the familiarization with the plant basic dynamics, different subsystems and normal plant operation but also malfunction situations. In the retraining most of the attention is devoted to the mastering of the disturbance and emergency situations. Some of these training sessions may include rather severe accident situations. The use of the simulator for research purposes has mainly focused on the human engineering and man-machine interface aspects of the training and plant operation. The display and handling of alarms have been studied by using simulated transients,

and the research has given impulses to concrete improvements in the control room. Another large research project has concerned the decision support during transients threatening plant safety. As a part of a comprehensive research plan on "Enhancing the mastery of work in process operation" statistics about operator errors during retraining has been collected and operators interviewed to reveal their internal process images, error mechanisms and sources.

30272 (INIS-BR—1049) **Reactor containment and reactor safety in the United States.** Kouts, H. (Brookhaven National Lab., Upton, NY (USA). Nuclear Energy Dept.). 1986. 17p. (CONF-8608221—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702313/JAW.

From Workshop on PWR reactor safety; Rio de Janeiro, Brazil (11 Aug 1986).

The reactor safety systems of two reactors are studied aiming at the reactor containment integrity. The first is a BWR type reactor and is called Peachbottom 2, and the second is a PWR type reactor, and is called surry. (E.G.).

30273 (INIS-BR—1067) **Flow with boiling in four-cusp channels simulating damaged core in PWR type reactors.** Esteves, M.M. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Engenharia Mecanica). 1985. 197p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702765/JAW.

The study of subcooled nucleate flow boiling in non-circular channels is of great importance to engineering applications in particular to Nuclear Engineering. In the present work, an experimental apparatus, consisting basically of a refrigeration system, running on refrigerant-12, has been developed. Preliminary tests were made with a circular tube. The main objective has been to analyse subcooled flow boiling in four-cusp channels simulating the flow conditions in a PWR core degraded by accident. Correlations were developed for the forced convection film coefficient for both single-phase and subcooled flow boiling. The incipience of boiling in such geometry has also been studied.

30274 (INIS-mf—11149) **Reliability in engineering '87. Conference proceedings.** Tuma, M. (ed.). (Ceskoslovenska Vedeckotechnicka Spolocnost, Banska Bystrica. Dom Techniky). 1987. 348p. (In Czech and Slovak). (CONF-8703259—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88702330/JAW.

From Conference on reliability in engineering; Piestany, Czechoslovakia (31 Mar 1987).

The participants heard 51 papers dealing with the reliability of engineering products. Two of the papers were incorporated in INIS, namely "Reliability comparison of two designs of low pressure regeneration of the 1000 MW unit at the Temelin nuclear power plant" and "Use of probability analysis of reliability in designing nuclear power facilities."(J.B.).

30275 (INIS-mf—11149, pp 100-106) **Reliability comparison of two designs of low pressure regeneration of the 1000 MW unit at the Temelin nuclear power plant.** Stvan, F.; Drab, J. (Skoda, Prague (Czechoslovakia). Vystavba Elektraren). 1987. (In Czech). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88702330/JAW. (CONF-8703259—).

From Conference on reliability in engineering; Piestany, Czechoslovakia (31 Mar 1987).

Simplified block diagrams are presented of the two designs. Design I is of a three-branch type and consists of a total of 12 small heaters. Design II is of a single-branch type and contains 6 heaters. During operation various combinations of heater failures may arise. Reliability analysis of the designs of low-pressure regeneration was carried out using the failure tree method. For failures of both designs the time of duration of these failures was calculated from the steady state coefficient of unavailability; from these times was derived the undelivered amount of power. The comparison only considered bare designs without any accessories. Of the two, design II may be considered better with regard to reliable operation. (J.B.). 3 figs., 1 tab., 6 refs.

30276 (INIS-mf—11149, pp 111-115) **Use of probability analysis of reliability in designing nuclear power facilities.** Holousova, M. (Vystavba Elektraren Skoda, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88702330/JAW. (CONF-8703259—).

From Conference on reliability in engineering; Piestany, Czechoslovakia (31 Mar 1987).

A critical evaluation is made of the existing method of assessing the reliability of the primary and secondary cooling circuits in the project design stage. Individual programs of quality assurance comprising all stages of the development and operation of the given equipment do not provide a satisfactory quality assurance such as would guarantee the safety of complex systems of primary circuit control. For most components of the secondary circuit such programs are non-existent and the components manufactured are of mediocre quality. In the primary circuit all measurements are carried out often in doubled majority logic of 2 out of 3. Realibility problems are studied in a number of research tasks, also through Czechoslovakia's involvement in the IAEA PRA/PSA program, i.e., the Probabilistic Risk (Safety) Assessment program. (J.B.). 4 refs.

30277 (INIS-mf—11169) **Evaluation of the influence of random deviations in input parameters on LOCA model predictions.** Boyadzhiev, A.I.; Totev, T.L. (Energoproekt, Sofia (Bulgaria)). 1984. 5p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702349/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A computational model for evaluating the influence of random variations in some reactor parameters on the fuel rodsurface temperature during large LOCA for WWER type reactors is described. The proposed procedure is based on one of the widely used methods for one-dimensional thermal hydraulic computations and can be successfully used for sensitivity analysis of the LOCA model predictions.

30278 (INIS-mf—11170) **District heating by the Bohunice nuclear power plant.** Metke, E.; Skvarka, P. (Energoproekt, Sofia (Bulgaria)). 1984. 11p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702350/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

Technical and economical aspects of district heating by the electricity generating nuclear plants in Czechoslovakia are discussed. As a first stage of the project, 240 MW thermal power will be supplied using bleeding lines steam from the B-2 nuclear power plant at Jaslovske Bohunice to heat up water at a central station to 130 grad C. The maximal thermal power that can be produced for district heating by WWER type reactors with regular condensation turbines is estimated to be: 465 MW for a WWER-440 reactor with two 220 MWe turbines and 950 MW for a WWER-1000 reactor with a Skoda made 1000 MWe turbine using a three-stage scheme to heat up water from 60 grad C to 150 grad C. The use of satelite heating turbines connected to the steam collector is expected to improve the efficiency. District heating needs will de taken into account for siting of the new power plants.

30279 (INIS-mf—11172) **Analysis of the WWER-440 pressure control system and the core thermal reliability.** Totev, T.; Boyadliev, A.I. (Energoproekt, Sofia (Bulgaria)). 1984. 13p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702352/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

Pressure deviations affect significanty the reactor core thermal reliability and it is of practical interest to analyze the reasons for these deviations. The paper presents a fault tree analysis of the pressurizer system during normal operation and a thermal reliability analysis of the reactor core. The TENAZ code is used for thermal reliability analysis assuming maximal deviation of 1% in the core inlet temperature, 4% in the local thermal power density, 20% in

the reactor power output and 5% in the effect of corrosion products on the CHF ratio. Calculation results illustrate the dependence of the amplifying factors on the heat flux when various CHF correlations are used, and the fault probability vs the maximal heat flux at various deviations in the core inlet pressure.

30280 (INIS-mf—11176) On a WWER-440 core power redistribution for more effective fuel management. Jordanova, P.; Pynevski, I.; Andreev, P. (Energoproekt, Sofia (Bulgaria)). 1984. 8p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702356/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

Operation of WWER-440 reactors with lower power density in the periferal fuel assemblies and higher loads in the central ones is considered and compared to the standardly recommended loading patterns. Computer simulation of several variants shows that such a mode of operation has a number of advantages: (i) Higher burnup in the central fuel assemblies which are to be removed during refueling; (ii) Lower neutron leakage and lower radiation loads of the reactor vessel; (iii) More uniform axial burnup of the fuel rods. Pireliminary thermal hydraulic calculations indicate that significant changes in the thermal reliability and reactor safety are not expected. Numerical results for a 60 grad C sector illustrate the basic core characteristics.

30281 (INIS-mf—11181) MAC type manipulators for maintenance and repair of WWER-440 primary coolant circuit. Toshev, Yu.E.; Tsvetkov, V.A.; Sapunov, A.D.; Nedev, N.N.; Filipov, B.G.; Stoenchev, S.S. (Energoproekt, Sofia (Bulgaria)). 1984. 6p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702360/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The concept of the design of a MAC telemanipulator for reactor maintenance works is summarized. The manipulator is to be used for visual inspection, deactivation, defectoscopy, protective varnishing of defect weldings, and other manipulations in the reactor core and the steam generators. An open kinematic circuit is used, with six degrees of freedom provided by four rotational and two translational kinematic couples of class V. Two types of drives are employed: hydraulic ones for all movements, with an additional possibility for rotation around the vertical axis, and electrical drives for all degrees of rotational movement. The controller is based on modules of the ISOMATIC series. The manipulator is operated by a qualified, specially trained operator and two assistants, not necessarily with special qualification. An automatic mode of operation is also available, with the operator able to intervene at any time.

30282 (INIS-mf—11183) Operation of the Kozloduj NPP units using the power and temperature reactivity effects at the end of the burnup cycle. Dichev, G.; Zlatev, Z.; Boyadzhiev, Z.; Zlateva, A.; Simov, R. (Energoproekt, Sofia (Bulgaria)). 1984. 5p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702362/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The excess reactivity released by the power and coolant temperature reactivity effects has been used to prolong the burnup cycle and to improve the fuel burnup of WWER-440 reactors. The effect of this mode of operation was 206 additional effective days, and $2x10^9$ KWh electric energy till the end of 1983. Excess reactivity is released in two stages: a) The turbine valves are fully open. Pressuire in the main stream collector is lowered to about 40 ata, resulting in a coolant temperatire decrease at the core inlet. The released reactivity is compensated by control rod insertion. Fuel burnup is compensated by control rods withdrawn so that pressure in the steam collector is kept constant. The reactor power output is nominal. 2) After the regulating rod bank is fully withdrawn, secondary pressure is kept constant by partly closing the turbine valve. Reactor thermal power is decreasing. Analysis of the results and the constraints shows that the effect is significant and can be optimized by taking into account the amount of planned maintenance works and the change in the energy cost.

30283 (INIS-mf—11184) Technical and economical aspects of distict heating by nuclear power plants with WWER-440 reactors. Batov, S.G.; Lakov, M.P.; Velev, V.A.; Kovachev, M.D.; Glukhov, G.A. (Energoproekt, Sofia (Bulgaria)). 1984. 8p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702363/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The possibility to use WWER type reactors with condensation turbines of the K-220-44 type for district heating along with electric power production is studied. The standard K-220-44 turbines are characterized by a large mass flow which permits the production of low-potential heat by the bleeding lines steam. Possible solutions of a number of technical and operational problems are illustrated by computer simulation of the turbine thermodynamic path for various bleeding flows. The computed results are used to derive collerations between the quantities of interest over the entire range of bleeding steam parameters. Economic aspects are studied ior several sets of steam and fiow parameters and available desigh data for the heat supply system of a small town near the power plant.

30284 (INIS-mf—11193) Numerical modelling of the processes in the WWER-1000 containment building during cold leg LOCA using the CONTEMPT-LT/026 code. Kolev, N.I.; Sybotinov, L.S. (Energoproekt, Sofia (Bulgaria)). 1984. 9p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702372/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The CONTEMPT-LT/026 code has been used to produce numerical results for the processes in a WWER-1000 containment building during cold leg LOCA with break at the reactor vessel. The objective of the analysis is to estimate the maximal loads on the containment in case of LOCA. Available design data for the geometry and for the operational characteristics of the low-pressure ECC system and the sprinkler system have been used. Boundary conditions such as mass flow and enthalpies at the breach are given by a RELAP4/MOD6 computation. Hydrogen explosions in the containment are not considered. It is found that in case of normal functioning of the low-pressure ECC system the maximal pressure is 3,26+-0,44 bar. In the case of malfunctioning of the low-pressure ECC system, the predicted maximal pressure is 4+-0,44 bar, when: a) only 50% of the heat transfer surface of the heat exchanger is effectively used due to pollution; b) the main pipeline of the sprinkler is broken; c) the pipeline to the heat exchanger is partially broken so that the mass flow through the exchanger is only 50% of the nominal; and d) ECC low-pressure ECC system attains its maximal efficiency within 3 min, the predicted maximal pressure is 4+-0,44 bar.

30285 (LA-UR—88-336) ENDF/B-V cell comparisons and MCNP-3A. Eich, W.J.; Eisenhart, L.D.; Little, R.C.; Mosteller, R.D.; Chao, J. (Electric Power Research Inst., Palo Alto, CA (USA); Levy (S.), Inc., Campbell, CA (USA); Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 8p. (CONF-880601—14).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

This study compares calculated results from the CELL-2 spectrum code to calculated results from the MCNP Monte Carlo code for typical pressurized water reactor (PWR) fuel lattices at elevated temperatures. The MCNP calculations represent the first analysis of commerical fuel lattices by continuous energy Monte Carlo at realistic temperaturs with ENDF/B-V data. Eigenvalue results demonstrate that the two codes agree to within the statistical uncertainty of MCNP. No systematic variations or biases appear as a function of enrichment or temperatute. This study constitutes the first verification of the reaction rates of CELL-2 and its processed ENDF/B-V data library via accurate numerical benchmarks.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 30257, 30325, 30326, 30327, 30355, 30362, 30379

30286 (CEA-DAS—369) Chernobylsk: site of nuclear accident. Faure, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jun 1987. 24p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753043/JAW.

The 26 April 1986, Chernobylsk has been the center of a major nuclear accident. The analysis of the site shows that this site was well fit for nuclear power reactor. The characteristics of population repartition and of the underground water-level has conducted the intervening conditions. Taking into account the fullness and the variety of actions made after the accident, it was desirable to degage a general return of this particular accident.

30287 (CONF-880578—1) Very-high-temperature reactors for future use. Kasten, P.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p.

From International symposium on strategy for innovation in materials processing: new challenge for the 21st. century; Osaka, Japan (17 May 1988).

Very-High-Temperature Reactors (VHTRs) show promise for economic generation of electricity and of high-temperature process heat. The key is the development of high-temperature materials which permit gas turbine VHTRs to generate electricity economically, at helium temperatures which can be used for fossil fuel conversion processes. 7 refs., 5 figs.

30288 (GA-A—19109) Effect of fuel burnup and cross sections on Modular HTGR [High-Temperature Gas-Cooled Reactor] reactivity coefficients. Lefler, W.; Baxter, A.; Mathews, D. (General Atomics Co., San Diego, CA (USA)). Dec 1987. Contract AC03-84SF11963. 26p. (CONF-871262—2).

From International Atomic Energy Agency's consultant meeting on reactor physics calculations using small computers; Vienna, Austria (8 Dec 1987).

The temperature dependence of the reactivity coefficient in a prismatic block Modular High-Temperature Gas-Cooled Reactor (MHTGR) design is examined and found to be large and negative. Temperature coefficient results obtained with the ENDF/B-V data library were almost the same as results obtained with the earlier versions of the ENDF/B data library usually used at GA Technologies Inc. (GA) in spite of a significant eigenvalue increase with the ENDF/B-V data. The effects of fuel burnup and arbitrarily assumed cross section variations were examined and tabulated.

30289 (Juel—2151) Investigations on water vapor-coal partial gasification in a helium heated vertical gas generator. Barnert, H.; Singh, J.; Hohn, H.; Romes, G.; Kalwitzki, H.; Kubiak, H.; Schroeter, H.J.; Alkemper, J.; Buchner, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.); Mannesmann Anlagenbau A.G., Duesseldorf (Germany, F.R.)). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.); Mannesmann Anlagenbau A.G., Duesseldorf (Germany, F.R.)). Jul 1987. 94p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753571/JAW.

Process engineering design and layout strategies for a gas generator in vertical construction (vs. horizontal construction in the past) of the process of watervapor-coal gasification to non-catalytical partial and complete gasification of bituminous coal are presented. The pilot plant for systems performance in the AVR and in full scale production for helium temperatures of 900°C and higher temperatures are shown.

30290 (ORNL/RAP—17) Decommissioning of the Molten Salt Reactor Experiment: A technical evaluation. Notz, K.J. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 94p.

This report completes a technical evaluation of decommissioning planning for the former Molten Salt Reactor Experiment, which was shut down in December, 1969. The key issues revolve around the treatment and disposal of some five tons of solid fuel salt which contains over 30 kg of fissionable uranium-233 plus fission products and higher actinides. The chemistry of this material is complicated by the formation of elemental fluorine via a radiolysis reaction under certain conditions. Supporting studies carried out as part of this evaluation include (a) a broad scope analysis of possible options for storage/disposal of the salts, (b) calculation of nuclide decay in future years, (c) technical evaluation of the containment facility and hot cell penetrations, (d) review and update of surveillance and maintenance procedures, (e) measurements of facility groundwater radioactivity and sump pump operation, (f) laboratory studies of the radiolysis reaction, and (g) laboratory studies which resulted in finding a suitable getter for elemental fluorine. In addition, geologic and hydrologic factors of the surrounding area were considered, and also the implications of entombment of the fuel in-place with concrete. The results of this evaluation show that the fuel salt cannot be left in its present form and location permanently. On the other hand, extended storage in its present form is quite acceptable for 20 to 30 years, or even longer. For continued storage in-place, some facility modifications are recommended. 30 refs., 5 figs., 9 tabs.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 30257, 30305

30291 (IAEA-TECDOC—443, pp 107-142) **Ontario Hydro's experience with simulator training.** Charlebois, P.R. (Ontario Hydro, Pickering (Canada). Eastern Nuclear Training Centre). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

The policy of Ontario Hydro has been to procure a full-scope simulator for each multi-unit nuclear plant. The responsibility of the overall simulator training programme is assigned to the Eastern and Western Nuclear Training Centres respectively while each plant is responsible for the content of the programme and the provision of supporting documentation. In addition, Ontario Hydro also developed small stand-alone computer simulators called micro-simulations which are used for part-task simulations. After a brief outline of the operator family structure the actual training programme for the various levels of plant staff is presented. The design process for an advanced and improved training programme, recently implemented, is described. Simulators are used in support of 3 overall areas: standard plant operation, integrated plant operation and refresher training. The techniques utilized for training delivery and assessment in each case are discussed. Finally the use of full-scope simulators for Operating Procedure validation is described. (author). 8 figs, 6 tabs.

30292 (INFO—0170) Canadian approach to protection against postulated primary heat transport piping failures. Jarman, B.L. (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Oct 1985. 8p. (CONF-8510337—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702283/JAW.

From Seminar on LEAK-BEFORE-BREAK: international policies and supporting research; Columbus, OH, USA (28 Oct 1985).

In Canada, the Atomic Energy Control Act and Regulations stipulate in broad terms the requirements to be met by licensees. In addition, AECB staff have prepared licensing guides to amplify those requirements. For nuclear reactors, these include providing suitable protection against the consequences of failure of any pipe

in the reactor cooling system. The suggested means of limiting the damage caused by whipping pipes or steam jets is by separation of equipment, installing barriers, or restraining piping. If, however, the designer can demonstrate that restraints are impractical or detrimental to safety, AECB staff may consider alternate arguments based on a demonstration that piping is likely to crack and then leak for a long time prior to rupture. This alternative approach would not be considered for ruptures having a high probability of defeating containment, damaging essential safety systems, or of disrupting flow to the core to the extent that fuel cooling could not be maintained.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 30328, 30329, 30372

30293 **(WAPD-TM—1298) The fabrication of fuel rod support grids for the Shippingport Light Water Breeder Reactor: LWBR Development Program.** Wittmann, R.P. (ed.); Cioletti, O.J.; Ebejer, L.P.; Glass, R.M.; Lynch, M.F.; Matchett, R.L.; Nilsen, R.J.; Payne, L.R.; Pitcairn, G.W.; Scharf, A. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 201p.

The fabrication of grids to support fuel rods in a close-packed hexagonal array for the Light Water Breeder Reactor (LWBR) is described. A variety of manufacturing and inspection processes, many of which were developed specifically for LWBR, were used in the grid fabrication process sequence. Among the unique operations performed were precision stamping of AM-350 stainless steel components, brazing of the components into the grid geometry, decarburization of the grids to the desired carbon level, and the measurement of grid dimensional characteristics utilizing a Coordinate Measuring Machine (CMM) with associated computerized data recording equipment. These processes, from basic component fabrication to final grid inspection, are described in detail and the significant problems encountered during the course of grid manufacture and inspection are dis cussed. 7 refs., 33 figs., 4 tabs.

30294 **Analytical model for dynamics of a sodium/water reaction bubble in an LMFBR steam generator and the coupled response of the intermediate heat transport system.** Shin, Y.W.; Youngdahl, C.K.; Ockert, C.E.; Wiedermann, A.H.; Eichler, T.V. (Argonne National Lab., IL (USA). Materials and Components Technology Div.; IIT Research Inst., Chicago, IL (USA); DeVry Inst. of Tech., Lombard, IL (USA)). *Nuclear Engineering and Design;* **106**: No. 2, 221-230(Feb 1988).

An analytical model and computational methods are presented to predict the dynamics of a sodium/water reaction bubble in the bulk of liquid sodium in the steam generator of a liquid metal reactor. The rate of reaction is based on a simple model including a parameter that must be deduced from test data. The computations include the coupled fluid response of the intermediate heat transport system. The analytical model was programmed in a computer code, and the computer code was used to analyze the results of large-scale SWR mockup tests. Comparison of the analytical results and the test data indicated generally good agreement despite the simplicity adopted in the reaction rate equation. Representative comparison results are presented and discussed. Implication of the empirical parameter included in the analytical model is discussed also.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

30295 **(SAND—87-1923C) Hydrogen turbines for space power systems: A simplified axial flow gas turbine model.** Hudson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 34p. (CONF-880122—12).

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

This paper descirbes a relatively simple axial flow gas expansion turbine mass model, which we developed for use in our space power system studies. The model uses basic engineering principles and realistic physical properties, including gas conditions, power level, and material stresses, to provide reasonable and consistent estimates of turbine mass and size. Turbine design modifications caused by boundary layer interactions, stress concentrations, stage leakage, or bending and thermal stresses are not accounted for. The program runs on an IBM PC, uses little computer time and has been incorporated into our system-level space power platform analysis computer codes. Parametric design studies of hydrogen turbines using this model are presented for both nickel superalloy and carbon/carbon composite turbines. The effects of speed, pressure ratio, and power level on hydrogen turbine mass are shown and compared to a baseline case 100-MWe, 10,000-rpm hydrogen turbine. Comparison with more detailed hydrogen turbine designs indicates that our simplified model provides mass estimates that are within 25% of the ones provided by more complex calculations. 8 figs.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 30263, 30292, 30380

30296 **(EGG-M—37186) Organization of Risk Analysis Codes for Living Evaluations (ORACLE).** Batt, D.L.; MacDonald, P.E.; Sattison, M.B.; Vesely, W.E. (EG and G Idaho, Inc., Idaho Falls (USA); Science Applications International Corp., Columbus, OH (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-870820—12).

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

ORACLE (Organization of Risk Analysis Codes for Living Evaluations) is an integration concept for using risk-based information in United States Nuclear Regulatory Commission (USNRC) applications. Portions of ORACLE are being developed at the Idaho National Laboratory for the USNRC. The ORACLE concept consists of related databases, software, user interfaces, processes, and quality control checks allowing a wide variety of regulatory problems and activities to be adressed using current, updated PRA information. The ORACLE concept provides for smooth transitions between on code and the next without pre- or post- processing. 3 figs.

30297 **(NUREG—0540-Vol.10-No.1) Title list of documents made publicly available: [Monthly report], January 1-31, 1988.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Mar 1988. 312p. NTIS, PC A14 - GPO. Order Number TI88900489/JAW.

The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number index.

30298 **(NUREG—0750-Vol.26-Index.1) Indexes to Nuclear Regulatory Commission issuances: July-September 1987.** (Nuclear Regulatory Commission, Washington, DC (USA)). Mar 1988. 41p.

Digests and indexes for insurances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions of Rulemaking are presented in this document.

30299 **(NUREG—0750-Vol.26-No.6) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Dec 1987. 88p.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

30300 **(NUREG—1303) Incident Investigation Manual.** (Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data). Feb 1988. 234p.

The Incident Investigation Manual prescribes guidelines for the conduct of investigative activities of the US Nuclear Regulatory Commission (NRC), Incident Investigation Teams (IITs). The purpose of this manual is to provide IITs guidance to ensure that NRC investigation of significant events are timely, structured, coordinated, and formally administered. The guidelines are intended to assist the investigation rather than limit the initiatives and good judgment of the team leader or members; they should use their experience and those techniques that provide the most confidence in assuring the IIT objectives are achieved.

30301 **(NUREG/CR—2000-Vol.7-No.2) Licensee Event Report (LER) compilation, for month of February 1988.** (Oak Ridge National Lab., TN (USA)). Mar 1988. 149p. (ORNL/NSIC—200-Vol.7-No.2).

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

30302 **(SNV—3268) Environmental effects of a preliminary phase out of nuclear power in Sweden.** Johansson, K.; Levander, T.; Liljelund, L.E. (National Swedish Environmental Protection Board, Solna). 1986. 98p. (In Swedish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753026/JAW.

From an environmental point of view it is important that the Swedish phase out of nuclear power is realized in such a way that: - hydroelectric power will not expand - fossil firing will be limited in order to minimize the increase of atmospheric CO/sb2/ content. Natural gas is preferred to other fossil fuels. - a continuation of the necessary restrictions in the pollution by sulfur- and nitrogen oxides is accomplished. Furthermore individual wood burning in densely built-up areas should be limited. (G.B.).

2108 Economics

REFER ALSO TO CITATION(S) 30346, 30402

30303 **(CONF-860601—1) Nuclear power options viability: Oak Ridge National Laboratory's study.** Gat, U.; Trauger, D.B.; White, J.D. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 29p.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

Seven criteria, augmented by desired characteristics, were established to assess the viability of nuclear reactors for the timeframe beginning at 2005 for the United States. Earlier nuclear power needs will be filled by LWRs. Several advanced concepts were selected, based on three ground rules, and assessed. It was concluded that there are several acceptable and viable concepts.

30304 **(DOE/OR/21400—T335) An introduction to the nuclear fuel cycle.** Leuze, R.E. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 68p. NTIS, PC A04;3. Order Number DE88007253/JAW.

This overview of the nuclear fuel cycle is divided into three parts. First, is a brief discussion of the basic principles of how nuclear reactors work;second, is a look at the major types of nuclear reactors being used and world-wide nuclear capacity;and third, is an overview of the nuclear fuel cycle and the present industrial capability in the US. 34 figs., 10 tabs.

30305 (INIS-mf—11168, pp 61-70) **Progress in modelling separated flow effect in the refilling of horizontal heated channels.** Ardron, K.H.; Barclay, F.W.; Hanna, B.N.; Mallory, J.; McDonald, B.H.; Scarth, D.; So, C.B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1983. NTIS (US Sales Only), PC A25/MF A01. Order Number DE88702348/JAW. (CONF-830932—).

From International conference on numerical methods in nuclear engineering; Montreal, Canada (6 Sep 1983).

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 31615

2201 Theory And Calculation

30306 **(AEEW-M—2318) 'POLY' Hole routine for the MONTE CARLO code MONK.** Bendall, D.E. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1986. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753082/JAW.

The paper presents the 'POLY' Hole routine for the Monte Carlo code MONK. The Hole routine enables the code to deal efficiently with situations which are difficult to treat with the more usual ray-tracing tracking techniques. The increase in efficiency arises because the code has only to determine the material present at each collision point during hole tracking. The POLY hole routine is described - the routine deals with nests of irregular polyhedrons. The nesting can be of any depth, and each polyhedron can have any number of faces. There can be any number of such nests provided they do not overlap. (U.K.).

2202 Components And Accessories

REFER ALSO TO CITATION(S) 30018, 30284, 30349, 30373, 30553

30307 **(EGG-M—40987) Reliability analysis of the INEL power system using fault trees and the IRRAS-PC computer code.** Galyean, W.J.; Close, J.A.; Fowler, R.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 7p. (CONF-880692—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007715/JAW.

From 15. INTER-RAM conference for the electric power industry; Portland, OR, USA (14 Jun 1988).

The Integrated Reliability and Risk Analysis System Personal Computer Version 2.0 computer code was used in a reliability analysis of the INEL Site Power System. This code was developed at the Idaho National Engineering Laboratory (INEL) as a state-of-the-art microcomputer-based probabilistic risk assessment (PRA) model and as an analysis tool for the U.S. Nuclear Regulatory Commission. IRRAS provided an efficient means for the development of a detailed and accurate fault tree model to: (a) identify the dominant causes of power outages on the site, (b) compare the performance of the system using both site-specific data and generic data, and (c) perform a sensitivity study to determine the effects of equipment unavailability caused by the ongoing preventative maintenance (PM) program. Although the final fault tree model exceeded the quantification capabilities of IRRAS, necessitating the use of the mainframe code SETS, IRRAS proved to be a valuable tool for both development of the fault tree model and preparation of the different inputs required to perform the analysis. The evaluation

was performed to gain the understanding necessary to determine whether the system, under INEL Power Management control, requires improvement of its reliability. This paper provides a detailed discussion of the methodology used for development of the fault tree model and evaluation of the reliability of the INEL Site Power System.

30308 **(EPRI-NP—5704M) On-line vibration monitoring for submerged vertical shaft pumps: Final report.** Walter, T.J.; Marchione, M.M. (Mechanical Technology, Inc., Latham, NY (USA)). Mar 1988. 227p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI8892071/JAW.

The overall goal of this project was to extend to vertical pumps the capability that presently exists to monitor and diagnose vibration problems in horizontal pumps. Specific objectives included the development of analytical techniques to interpret vibration measurements, the verification of these techniqeus by in-plant tests, and the development of recommendations for procuring submergible vibration sensors. A concurrent analytical and experimental approach was used to accomplish these objectives. Rotordynamic analyses of selected pumps were accomplished, and each pump was instrumented and monitored for extended periods of time. The models were used to determine important frequencies and optimum sensor locations and to predict the effect that wear, imbalance, misalignment, and other mechanical changes would have on measured vibration. The predictive ability of the models was confirmed by making changes to instrumented pumps and observing actual changes in pump vibration. Simplified guidelines have been developed to assist the interested user to develop a computer model that realistically predicts the rotordynamic performance of the installed pump. Based on the work accomplished, typical sensor locations have been established. Experience gained in application of commercially available submergible sensors is also related. 11 refs., 11 figs.

30309 **(INIS-BR—1066) Application of Quasi-Newton methods to the analysis of axisymmetric pressure vessels.** Parisi, D.A.C. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). 1987. 185p. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88702764/JAW.

This work studies the application of Quasi-Newton techniques to material nonlinear analysis of axisymmetrical pressure vessels by the finite element method. In the formulation the material bahavior is described by an isotropic elastoplastic model with strain hardening. The continum is discretized through triangular finite elements of axisymmetrical solids with linear interpolation of the displacement field. The incremental governing equations are derived by the virtual work. The solution of the system of simultaneous nonlinear equations is solved iteratively by the Quasi-Newton method employing the BFGS update. The numerical performance of the proposed method is compared with the Newton-Raphson method and some of its variants through some selected examples.

2203 Fuel Elements

30310 **(NUCLEBRAS-CDTN—555) Physical and chemical characterization of the (Th, U)O_2 mixed oxide fuel.** Santos, A.M.M. dos; Avelar, M.M.; Palmieri, H.E.L.; Lameiras, F.S.; Ferreira, R.A.N. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 24p. (In Portuguese). (CONF-860343—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701705/JAW.

From 1. general congress on nuclear energy; Rio de Janeiro, Brazil (17 Mar 1986).

The Nuclebras R and D Center (Centro de Desenvolvimento da Tecnologia Nuclear - CDTN) has been performing, together with german institutions (Kernforschungsanlage Juelich GmbH - KFA, Kraftwerk Union A.G. KWU NUKEM Gmbh), a program for utilization of thorium in pressurized water reactors. In this paper are presented the physical and chemical chacterizations necessary to qualify the (Tn, U)O_2 and the respective methods.

2204 Control Systems

REFER ALSO TO CITATION(S) 30358, 30384

30311 **(AECL—8959) MVPACK: a computer-aided design tool for multivariable control systems.** Mensah, S.; Frketich, G. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1985. 14p. (CONF-8405389—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702212/JAW.

From Canadian conference on industrial computers; Ottawa, Ontario, Canada (22 May 1984).

The design and analysis of high-performance controllers for complex plants require a collection of interactive, powerful computer software. MVPACK, an open-ended package for the computer-aided design of control systems, has been developed in the Reactor Control Branch of the Chalk River Nuclear Laboratories. The package is fully interactive and includes a comprehensive state-of-the-art mathematical library to support development of complex, multivariable, control algorithms. Coded in RATFOR, MVPACK is portable with minimal changes. It operates with a flexible data structure which makes efficient use of minicomputer resources and provides a standard framework for program generation. The existence of a help mechanism enhances the simplicity of package utilization. This paper provides a brief tutorial overview of the package. It reviews the specifications used in the design and implementation of the package and briefly describes the database structure, supporting libraries and some design and analysis modules of MVPACK. Several application examples to illustrate the capability of the package are given. Experience with MVPACK shows that the package provides a synergistic environment for the design of control and regulation systems, and that it is a unique tool for training of control system engineers.

30312 **(INIS-mf—11171) Research and development in the automation of WWER power plants in Czechoslovakia.** Matoushek, M.; Stirsky, P. (Energoproekt, Sofia (Bulgaria)). 1984. 10p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702351/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A brief review is given of the activities in reactor control and instrumentation at Czechoslovak institutes. Main topics are: mathematical modeling and simulation studies of WWER reactor dynamics including the controllers and the safety system; development of methods and codes for the control and safety systems; reliability analisys; tuning of the control system during reactor start-up experiments, using computerized simulation; computerized data processing.

30313 **(INIS-mf—11174) Simulation and stochastic control of the axial core power distribution in a water cooled reactor.** Korbicz, J.; Zgurovsky, M.Z. (Energoproekt, Sofia (Bulgaria)). 1984. 10p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702354/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A stochastic control problem is formulated for a water cooled power reactor, using an one-dimensional neutron diffusion model. The control system is assumed to consist of a suboptimal state estimator and a feedback controller. The approach presented allows to take into account the basic properties of the real system, such as the stochastic nature of the power generation, nonlinearity, inaccuracies and the discrete character of the measurements. Simulation results illustrate the good performance of the system in case of large disturbances, in the presence of measurement noise. The algorithms are implemented in a program package intended for NPP personnel training.

30314 **(INIS-mf—11182) Adaptive control of nonlinear point reactor.** Burev, D.; Dimitrov, D.; Ovcharova, J.; Avramov, I.; Kolev, N.P.; Velkov, K. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (Energoproekt, Sofia (Bulgaria)). 1984. 6p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702361/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

Parameter identification and adaptive control schemes are presented for a nuclear reactor with point kinetics. The system is nonlinear due to the internal feedbacks. Measured plant outputs are used to estimate the realizations of nonobservable disturbances (in case of stochastic models), and to identify model parameters and noise predictor parameters. Noise disturbances are assumed non-observable, with unknown statistical characteristics and can be correlated with their pre-history, with the state variables and control inputs. In the case of adaptive control plant parameters can adaptively be adjusted through control inputs to reduce the output error between the model and the plant. The predictors of state and noise are linear with respect to the control inputs and permit the use of explicit expressions for the controls. Deterministic and stochastic variants of the system have been investigated using relatively simple linear and nonlinear models. Optimal parameters of the controller (in sense of minimal mean square error) have been designed and used in the comparative study. The plant have a nuclear reactor of WWER type, described by a nonlinear model including point kinetics, core and primary circuit thermal hydraulics and fission product poisoning. Computer simulation results inducate that: a) adaptive schemes investigated are satisfactory enough to ensure stable control of WWER reactor power output; b) yhe performance index is improved in case of stochastic models which permit compensation of the uncertainties due to unknown parameters.

30315 **(RISO-M—2417) Information interfaces for process plant diagnosis.** Lind, M. (Risoe National Lab., Roskilde (Denmark)). Feb 1984. 34p. (CONF-8311311—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753014/JAW.

From Conference on data communication in distributed systems; Lyngby, Denmark (2 Nov 1983).

The paper describes a systematic approach to the design of information interfaces for operator support in diagnosing complex systems faults. The need of interpreting primary measured plant variables within the framework of different system representations organized into an abstraction hierarchy is identified from an analysis of the problem of diagnosing complex systems. A formalized approach to the modelling of production systems, called Multilevel Flow Modelling, is described. A MFM model specifies plant control requirements and the associated need for plant information and provide a consistent context for the interpretation of real time plant signals in diagnosis of malfunctions. The use of MFM models as a basis for functional design of the plant instrumentation system is outlined, and the use of knowledge Based (Expert) Systems for the design of man-machine interfaces is mentioned. Such systems would allow an active user participation in diagnosis and thus provide the basis for cooperative problem solving. 14 refs.

30316 **(RISO-M—2664) Role of information technology in emergency management: Expert system or cognitive instrument?.** Vicente, K.J. (Risoe National Lab., Roskilde (Denmark)). Sep 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753018/JAW.

The purpose of the NKA/INF project is to improve the functionality and efficiency of accident and emergency planning by verifying, demonstrating, and validating the possible implementation of advanced information technology. This paper is concerned with the role that such an information system should take. It is argued that the role that has been adopted, that of a classical expert system, may not be the most appropriate, given the characteristics of the problem. An alternative role for the system is proposed, that of a cognitive instrument. This perspective should be able to effectively address the problems of the domain in a manner that will maximize the performance and reliability of the joint humancomputer system. 13 refs.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 30302, 30334, 30344, 30355, 30363, 30364, 30372, 30373, 30383, 31075

30317 **(INIS-mf—11179) On risk assessment of nuclear power developement.** Kalchev, B.; Gencheva, D. (Energoproekt, Sofia (Bulgaria)). 1984. 7p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702358/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

An approach to risk evaluation of nuclear power development is presented. The obtained values for both individual and collective risks for the population in the vicinity of nuclear plants are compared with the corresponding permissible values.

30318 **(RISO-M—2655) Method for consequence calculations for severe accidents. Release from Ringhals 3/4 through scrubber caused by total power failure.** Nielsen, F. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 68p. (In Danish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753017/JAW.

This report was commissioned by the Swedish State Power Board. The report contains a calculation of radiation doses in the surroundings caused by a theoretical core meltdown accident at Ringhals reactor No 3/4. The accident sequence chosen for the calcualtions was a release caused by total power failure. The calculations were made by means of the PLUCON4 code. A decontamination factor of 500 is used to account for the scrubber effect. Meteorological data for two years from the Ringhals meteorological tower were analysed to find representative weather situations. As typical weather, Pasquill D, was chosen with a wind speed of 10 m/s, and as extreme weather, Pasquill E, with a wind speed of 2 m/s. 19 refs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 30159, 30354, 30557, 31448

30319 **(AEEW-R—2245) Calculations for the intermediate-spectrum cells of Zebra 8 using the MONK Monte-Carlo Code.** Hanlon, D.; Franklin, B.M.; Stevenson, J.M. (UKAEA Atomic Energy Establishment, Winfrith). Oct 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752743/JAW.

The Monte-Carlo Code MONK 6A and its associated point-energy cross-section data have been used to analyse seven, zero-leakage, plate-geometry cells from the ZEBRA 8 assemblies. The convergence of the calculations was such that the uncertainties in k-infinity and the more important reaction-rate ratios were generally less than the experimental uncertainties. The MONK 6A predictions have been compared with experiment and with predictions from the MURAL collision-probability code. This uses FGL5 data which has been adjusted on the basis of ZEBRA 8 and other integral experiments. The poor predictions from the MONK calculations with errors of up to 10% in k-infinity, are attributed to deficiencies in the database for intermediate to fast spectrum systems.

30320 **(EGG-PHY—7792) ARMF [Advanced Reactivity Measurement Facility] 6x6 Fast Flux Facility.** Napper, P.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 15p.

The ARMF 6x6 Fast Flux Facility provides a unique experimental test position for large experiments requiring fast (1 MeV) neutron flux environments. Neutron fluence levels as high as 10_{16} ncm^2 can now be achieved on large completed test assemblies in this facility. This facility will provide a valuable service for the testing of electronic, optical and various other materials or components that are subject ot either nuclear or space radiation effects.

30321 **(INIS-GB—122) [The Universities Research Reactor]. Annual report 1986-1987.** (Universities Research Reactor, Risley (UK)). 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752751/JAW.

The paper presents the annual report 1986-1987 of the Universities Research Reactor, United Kingdom. The reactor and associated laboratories were well utilised during the year. The demand for radioactive isotopes has increased over previous years, with 5592 samples irradiated in the 12 month period. The contents of the report contains a description of: the research programme, activation analysis service, teaching programme, and reactor operation and safety arrangements. (U.K.).

30322 **(ORNL/TM—10635) Bulk Shielding Facility: Quarterly report, July, August, and September 1987.** Muggridge, F.E.; Fancher, T.L.; Duggins, W.A. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 15p.

The Builk Shielding Reactor (BSR) remained shutdown during July, August, and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The PCA is shutdown for shim-safety rod magnets and associated electronic components upgrading. 11 tabs.

30323 **(ORNL/TM—10717) Bulk Shielding Facility: Quarterly report, October, November, and December 1987.** Muggridge, F.E.; Duggins, W.A. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 18p.

The Bulk Shielding Reactor (BSR) remained shutdown during October, November, and December. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The Pool Critical Assembly (PCA) is shutdown for shim-safety rod magnets and associated electronic components upgrading.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 30356, 30357, 30368, 30369

2208 Propulsion Reactors

30324 **(AD-A—189234/8/XAB) SOAR: Space Orbiting Advanced Fusion Power Reactor. Final report, October 1986-January 1987.** Kulcinski, F.L.; Santarius, J.F. (Wisconsin Univ., Madison (USA)). Sep 1987. 57p. NTIS, PC A04/MF A01.

The preconceptual design of a Space Orbiting Advanced Fusion Power Reactor (SOAR), which delivers up to 1000 MWe for at least 600 s from an orbited mass of about 500 tonnes, was accomplished. The power is produced by a magnetically confined D-3He plasma. Approximately 96% of the fusion energy is in charged particles, and a direct converter has been designed which converts much of this energy into electricity at high net efficiency (about 80%). An advanced shield design allows SOAR to deliver approximately 2 kilowatts of electricity for every kilogram of material orbited. The shield is designed to absorb all rejected heat during operation, and no active radiator is required. The SOAR reactor concept is designed to allow rapid startup and shutdown procedures. The lack of radioactivity on launch and the low radioactive inventory after operation make the SOAR concept attractive from maintenance, safety and environmental perspectives. The plasma physics approach extrapolates from the present plasma physics and fusion technology knowledge base using concepts which can be tested on existing or near-term devices. The symbiosis of burst mode requirements, D-3He tandem mirror fusion reactor characteristics, and the space environment leads to a very high performance design concept.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 30260, 30267, 30296, 30300, 30318, 30751, 31615, 31718

30325 **(BNL-NUREG—40361) Depressurized core heatup accident scenarios in advanced modular high temperature gas cooled reactors.** Kroeger, P.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 12p. (CONF-880532—16).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

The decay heat removal by a passive air colling system from a modular high tempeature gas cooled reactor during depressurized core heatup accident scenarios was analyzed. The effects of several design and operating parameters on the peak fuel and vessel temperatures were established. The results indicate that fuel and vessel temperatures remain well below failure levels and that significant safety margins exist in the key variables of decay heat and core thermal conductivities.

30326 **(BNL-NUREG—40362) Hypothetical air ingress scenarios in advanced modular high temperature gas cooled reactors.** Kroeger, P.G. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880532—1).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

Considering an extremely hypothetical scenario of complete cross duct failure and unlimited air supply into the reactor vessel of a modular high temperature gas cooled ractor, it is found that the potential air inflow remains limited due to the high friction pressure drop through the active core. All incoming air will be oxidized to CO and some local external burning would be temporarily possible in such a scenario. The accident would have to continue with unlimited air supply for hundreds of hours before the core structural integrity would be jeopardized.

30327 **(BNL-NUREG—40364) MINET [Momentum Integral NETwork] analysis of MHTGR [Modular High Temperature Gas-Cooled Reactor] moisture-ingress transient.** Yang, J.W.; Kroeger, P.G.; Van Tuyle, G.J.; Aronson, A.L. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-880532—7).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

The transient which involved a steam-generator tube leak and the ingress of moisture into the primary coolant system of the standard Modular Modular High Temperature Gas-Cooled Reactor (MHTGR) is analyzed by using the MINET (Momentum Integral NETwork) computer code. The analysis provides detailed information on the effect of power excursion on transient system pressures and temperatures. It is concluded that during the short term transient period the moisture ingress presents no threat to the integrity of the fuel elements and does not lead to pressures which would cause relief valve opening and fission product release.

30328 **(BNL-NUREG—40366) A simple model for radial expansion reactivity in LMRs [liquid metal reactors].** Cheng, H.S.; Van Tuyle, G.J. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880532—3).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

Presented in this report is a simple analytical model developed for evaluating the radial expansion reactivity in small modular liquid metal reactors (LMRs). The present model is based on a non-leakage representation of the effective neutron multiplication factor. The resultant analytical expression for the radial expansion reactivity is simple and can be used directly in a system code for safety analyses. Applications of the present model to PRISM and SAFR resulted in a good agreement with the values reported by vendors. This agreement establishes that the large negative reactivity insertion resulting from LMR core radial expansion can be confirmed using a simple analytical approach, and thus is important in the cur-

rent effort to evaluate the reactor inherent feedbacks for the PRISM and SAFR designs.

30329 **(BNL-NUREG—40368) Evaluation of postulated LOF [loss-of-flow] events in PRISM and SAFR.** Chan, B.C.; Van Tuyle, G.J.; Slovik, G.C.; Aronson, A.L. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-880532—5).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

The PRISM and SAFR designs, as currently proposed by DOE, are designed for "inherent", as opposed to "engineered", safety. Brookhaven National Laboratory is supporting the initial NRC review of these advanced LMR concepts. A loss-of-flow (LOF) accident coupled with a failure of the reactor shutdown system is one of the major safety concerns in the advanced liquid metal reactor (LMR) evaluation effort. The analysis discussed here covers: (1) primary pipe break without pump trip, (2) primary coolant pump seizure, and (3) primary coolant pump coastdown. The analytical modelling and the calculated thermal and hydraulic behavior are described in detail.

30330 **(BNL-NUREG—40750) An integral approach for calculating uncertainties in consequences from nuclear reactor accidents.** Madni, I.K.; Cazzoli, E.G.; Khatib-Rahbar, M.; Tingle, A. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880601—18).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

This paper presents a Personal Computer-based model that uses an integral approach for calculation of early off-site consequences resulting from nuclear power plant accidents. The computing time requirements for a typical calculation on a mainframe computer using this model are two orders of magnitude lower than those of CRAC2 and MACCS codes, thus providing a valuable tool for sensitivity and uncertainty studies. The model predicts time-integrated air concentration of each radionuclide at any location from release as a function of time-integrated source strength using the Gaussian plume model. The concentration can be calculated at the centerline of a Gaussian profile or, optionally, as an average over the cross-section based on a top-hat distribution. The solution procedure involves direct analytic integration of air concentration equations over time and position. This is different from the differential approach currently used in CRAC2 and MACCS codes. The present model uses simplified meteorology. Dispersion parameters are calculated from exponential fits to the Pasquill-Gifford curves for six atmospheric stability classes designated A to F, and from an approximation as indicated in Reg. guide 1.145 for the seventh stability class G (extremely stable). 8 refs., 2 figs.

30331 **(BNL-NUREG—40751) Uncertainties in source term estimates for a station blackout accident in a BWR with Mark I containment.** Lee, M.; Cazzoli, E.; Liu, Y.; Davis, R.; Nourbakhsh, H.; Schmidt, E.; Unwin, S.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 8p. (CONF-880601—17).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

In this paper, attention is limited to a single accident progression sequence, namly a station blackout accident in a BWR with a Mark I containment building. Identified as an important accident in the draft version of NUREG-1150 a station blackout involves loss of both off-site power and dc power resulting in failure of the diesels to start and in the unavailability of the high pressure injection and core isolation cooling systems. This paper illustrates the calculated uncertainties (Probability Density Functions) associated with the radiological releases into the environment for the nine fission product groups at 10 hours following the initiation of core-concrete interactions. Also shown are the results ofthe STCP base case simulation. 5 refs., 1 fig., 1 tab.

30332 **(BNL-NUREG—40754) Interfacing system LOCAs at PWRs [pressurized water reactors]: A new assessment.** Bozoki, G.; Kohut, P.; Fitzpatrick, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 4p. (CONF-880601—16).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Interfacing system loss-of-coolant accidents (ISL) were first identified and analyzed in the Reactor Safety Study (RSS). ISLs were found to be significant contributors to the risk estimates for the presurized water reactor (PWR) analyzed in the RSS. Some evaluations of ISL sequences in subsequent studies have also found that their contribution to risk is also significant. ISLs are potentially important to risk because a direct path is opened from the damaged reactor core which bypasses the containment building. Thus, these sequences can potentially result in a signfiicant fission product release to the environment. In spite of the numerous analyses conducted in various Probabilistic risk Assessment (PRA) Studies during recent years, the models and assumptions used to describe ISLs are subject to substantial uncertainties. In addition, recent studies performed within the framework of the Industry Degraded core Rulemaking Program (IDCOR) indicate that previous ISL analyses may result in overly conservative results. In order to provide more realistic estimates for the core damage frequencies (CDFs) and a reduction in the magnitude of the uncertainties, a re-examination of the ISL sequences at PWRs has been performed at Brookhaven National Laboratory.

30333 **(BNL-NUREG—40756) An analysis of risk reduction methods for interfacing system LOCAs at PWRs.** Kohut, P.; Bozoki, G.; Fitzpatrick, R. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880601—15). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006295/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Interfacing system loss-of-coolant accidents (ISLs) refers to events where the integrity of the Reactor Coolant System (RCS) pressure boundary is breached through failure of isolation valves which separate a support system of lower design pressure. The overpressurization of the support system will affect its availability and may further affect the availability of various safety systems required to mitigate the accident. In addition, it may result in a scenario where primary coolant is directly discharged into the outside environment by passing the containment. The Reactor Safety Study (WASH-1400) predicted that ISL events were significant contributors to risk even though they were calculated to be relatively low frequency events. However, there are substantial uncertain involved in determining the probability and consequences of the ISL sequences. For example, the assumed valve failure modes, common cause contributions and the location of the break/leak are all uncertain and can significantly influence the predicted risk from ISL events. The present study was performed to investigate the vulnerability of pressurized water reactor designs to ISLs and identify any improvements that could significantly reduce the frequency of these events.

30334 **(CEA-DAS—389) Influence of structural insoluble aerosols in severe accident scenarios with and without steam condensation onto soluble aerosols fission products.** Gauvain, J.; Lhiaubet, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 13p. (CONF-8709119—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753044/JAW.

From Workshop on water-cooled reactor aerosol code evaluation and uncertainty assessment; Brussels, Belgium (9 Sep 1987).

In severe accident occurring on a PWR the release of material from the core include various species: insoluble aerosols (composed mainly of structural materials) and soluble (aerosols composed mainly of CsI, CsOH and Te). Considering a S_2CD severe accident scenario with different assumptions concerning aerosols release and steam bulk condensation on the aerosols, a set of 24 calculations was performed with the AEROSOLSB2 code able to manage two different types of particles (density, size distribution, solubility). In the first part of the study, aerosols fission products (F.p.) are supposed to be released into the containment without structural material. The influence of source size distribution, mass flow rate, diffusiophoresis and bulk steam condensation on aerosols behaviour is analysed in terms of suspended mass remaining 24 hours after the f.p. release starts. In the second part of the study structural aerosols are supposed to be released into the containment

during and after the aerosols f.p. The influence of source size distribution, density, mass flow rate, diffusiophoresis, bulk steam condensation on aerosols, considered as partly soluble or insoluble, is analysed in terms of suspended mass remaining 24 hours after the f.p. release starts.

30335 **(CEA-DAS—391) Probabilistic analysis of 900 MWe PWR. Shutdown technical specifications.** Mattei, J.M.; Bars, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 6p. (CONF-870820—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753046/JAW.

From PSA 87: international topical meeting on probabilistic safety assessment and risk management; Zurich, Switzerland (31 Aug 1987).

During annual shutdown, preventive maintenance and modifications which are made on PWRs cause scheduled unavailabilities of equipment or systems which might harm the safety of the installation, in spite of the low level of decay heat during this period. The pumps in the auxiliary feedwater system, component cooling water system, service water system, the water injection arrays (LPIS, HPIS, CVCS), and the containment spray system may have scheduled unavailability, as well as the power supply of the electricity boards. The EDF utility is aware of the risks related to these situations for which accident procedures have been set up and hence has proposed limiting downtime for this equipment during the shutdown period, through technical specifications. The project defines the equipment required to ensure the functions important for safety during the various shutdown phases (criticality, water inventory, evacuation of decay heat, containment). In order to be able to judge the acceptability of these specifications, the IPSN, the technical support of the Service Central de Surete des Installations Nucleaires, has used probabilistic methodology to analyse the impact on the core melt probability of these specifications, for a French 900 MWe PWR.

30336 **(CEA-DAS—392) Use of probabilistic methods for the improvement of technical specifications.** Gros, G.; Mattei, J.M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 10p. (CONF-870973—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753047/JAW.

From Specialist meeting on improving technical specifications for nuclear power plants; Madrid, Spain (7 Sep 1987).

The technical specifications set the requirements related to the availability of equipment. In order to limit the risk when an unavailability is noticed during power operation, an allowed outage time is determined based on a fixed limit imposed on the increase of calculated core melt probability when the equipment is considered as unavailable. An example related to the main electric equipment is presented. In case of cold shutdown condition, the operations carried out lead to numerous programmed unavailabilities of equipment. For the examination of a project of technical specifications defining the necessary equipment in the diffrent phases encountered, evaluation of the increase of the core melt probability due to the unavaibilities has been made.

30337 **(CEA-DAS—393) Periodical test program in depth revision.** Feltin, C.; Zermizoglou, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 8p. (CONF-870973—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753048/JAW.

From Specialist meeting on improving technical specifications for nuclear power plants; Madrid, Spain (7 Sep 1987).

Inspection visits made to different sites during 1980 and 1981 evidenced the need to extend and define more precisely the periodical tests performed on safety related systems; thus Electricite de France was requested by the Safety Authorities to re-examine the periodical test program for all safety related systems. This paper presents the methodology adopted by Electricite de France in order to perform an exhaustive analysis of the periodical test program for the 900 and 1300 MWe plants, and the organization set up at the IPSN at one hand and Electricite de France on the other hand for the purpose of elaborating a periodical test program which would be ratified by the Safety Authorities.

30338 **(CEA-DAS—403) Safety improvement by lessons from exploitation experience (other than incidents).** Levy, D.B.; Wallard, H.E.; Jardel, J.R.; Cernes, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 14p. (In French). (CONF-870911—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753050/JAW.

From International conference on the technical and economic performance of nuclear power; Vienna, Austria (28 Sep 1987).

The experience return is made in France, by incidents studies. But the experience return can be made by other informations before incidents. These informations are of 3 types: informations collected in inspections by safety authorities, informations collected by the operational control and by an improvement of the knowledge. This approach makes the return experience descended from incidents analysis more complete.

30339 **(CEA-DAS—404) Aid for elaboration of operating technical specifications for a PWR by probabilistic studies.** Levy, D.; Dubreuil-Chambardel, A.; Mattei, J.M.; Bars, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 13p. (In French). (CONF-870911—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753051/JAW.

From International conference on the technical and economic performance of nuclear power; Vienna, Austria (28 Sep 1987).

In this paper the authors show how the probabilistic studies are used for the elaboration of operating technical specifications. This probabilistic study is made on the residual heat removal system. The probability of core meltdown is made principally by gamming, in open position, of valves of this circuit. The return is a modification of valves conception and a modification of the operating mode.

30340 **(CEA-DAS—405) Organization, in safety organisms, of experience return for incident analysis.** Dredemis, G.; Giroux, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 11p. (In French). (CONF-870911—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753052/JAW.

From International conference on the technical and economic performance of nuclear power; Vienna, Austria (28 Sep 1987).

This communication presents the methodology used by French safety organisms for extracting all the lessons of operating experience and incidents.

30341 **(CEA-DAS—436) Severe accident research in France.** Duco, J.; Reocreux, M.; Tattegrain, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jan 1988. 47p. (CONF-871279—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753054/JAW.

From 11. NSRR and severe accident research review meeting; Tokyo, Japan (11 Dec 1987).

French PWR power plant design relies basically on a deterministic approach. Nevertheless, an overall safety objective was issued in 1977 by the safety authority which set an upper probability limit for having unacceptable consequences; this resulted, in particular, in the elaboration of the "H" procedures, aimed at reducing significantly the risk of core uncovery subsequent to the loss of redunbant safety-related systems. The U1 symptom-oriented procedure, based on the nuclear steam supply system "cooling states", was introduced later, in order to prevent core melting in situations where the operating crew was confused by multiple failures and/or inappropriate previous actions. In the event that a core-melt should occur, the ultimate procedures U2, U4 and U5 - the latter providing a venting of the containment through a filtration system - should enable the radioactive releases to be limited to characteristics compatible with the feasibility of the off-site emergency plans. Such emergency management procedures necessitate a significant study effort in order to be elaborated and qualified; this also presupposes that an adequate level of scientific knowledge has been gained as regards the response of specific components of a PWR under beyond-design conditions. The purpose of severe accident re-

search in France is to attain a level of basic knowledge such that emergency procedures may be conceived and ultimately tested.

30342 **(CONF-860601—2) The ultimate safe (US) Reactor: A concept for the third millenium.** Gat, U. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 13p.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

The Ultimate Safe (U.S.) Reactor is based on a novel safety concept. Fission products in the reactor are allowed to accumulate only to a level at which they would constitute a harmless source term. Removal of fission products also removes the decay heat - the driving force for the source term. The reactor has no excess criticality and is controlled by the reactivity temperature coefficient. Safety is inherent and passive. Waste is removed from the site promptly.

30343 (CONF-8605117—, pp 187-193) **Workshop to exchange and transfer knowledge for the purpose of increasing public understanding relating to nuclear safety and to provide a forum for discussion of alternatives available to promote revitalization of nuclear power in the US.** Cranston, G.V. (Bechtel Power Corp., San Francisco, CA (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper proposes an information dissemination program to adequately familiarize the public with the actual health and safety risks of nuclear energy development. It plans for a discussion panel for alternatives available to promote revitalization of nuclear power in the US. It also provides for technology transfer between contractors, designers, and training staff. It recognizes problem areas in licensing and certification by the Nuclear Regulatory Commission and ways to standardize the administrative procedures.

30344 **(CONF-8610135—66) Summary of aerosol code-comparison results for LWR [Light-Water Reactor] aerosol containment tests LA1, LA2, and LA3: [Final report].** Wright, A.L.; Wilson, J.H.; Arwood, P.C. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 9p.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Light-Water Reactor (LWR) Aerosol Containment Experiments (LACE) are being performed in Richland, Washington, at the Hanford Engineering Development Laboratory (HEDL) under the leadershiop of an international project board and the Electric Power Research Institute. These tests have two objectives: to investigate, at large scale, the inherent aerosol retention behavior in LWR containments under simulated severe accident conditions, and to provide an experimental data base for validating aerosol behavior and thermal-hydraulic computer codes. Aerosol computer-code comparison activities for the LACE tests are being coordinated at the Oak Ridge National Laboratory. For each of the six experiments, "pretest" calculations (for code-to-test data comparisons) are being performed. This paper presents a summary of the pretest aerosol-code results for tests LA1, LA2, and LA3. 7 refs., 11 figs., 2 tabs.

30345 **(CONF-8710194—2) Natural convection phenomena in a nuclear power plant during a postulated TMLB' accident.** Domanus, H.M.; Schmitt, R.C.; Sha, W.T.; Shah, V.L.; Han, J.T. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). 1987. Contract W-31109-ENG-38. 15p.

From Heat transfer symposium; Urbana, IL, USA (1 Oct 1987).

After the TMI (Three Mile Island) accident, there has been significant interest in analyzing and understanding the phenomena that may occur in a PWR (Pressurized Water Reactor) accident which may lead to partial or total core meltdown and degradation. Natural convection is one of the important phenomena. In the present paper the results of two numerical simulations of (1) four-loop PWR and (2) three-loop PWR are presented. The simulations were performed with the COMMIX[2] computer code. Our analysis shows that in severe accident scenarios, natural convection phenomena does occur and that it helps to delay core degradation by transferring decay heat from the reactor core to other internal structures of the reactor system. The amount of heat transfer and delay in core degradation depends on the geometry and internal structures of the system and on the events of an accident.

30346 **(DOE/SSDP—0039) Removal and transportation of reactor pressure vessel neutron shield tank (RPV/NST) package.** Coughlin, P.J. (USDOE Shippingport Station Decommissioning Project Office, PA). 1988. Contract AC06-84RL10421;AC06-76RL01857. 5p. (CONF-880601—22).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The Shippingport Station Decommissioning Project (SSDP) is a US Department of Energy (DOE) sponsored project to dismantle the Shippingport Atomic Power Station (SAPS) and return the government-leased property in a radiologically safe condition to its owner, Duquesne Light Company. One key feature of the project includes the removal of the RPV/NST package from its existing location at SAPS and its transportation by barge to the government-owned Hanford Reservation in Richland, Washington. The package, which consists of the RPV, its non-fuel-bearing internals, and the integral Neutron Shield Tank (NST), will be prepared as a monolithic metal/concrete package for shipment. The package which is about 5.1 meters (18') in diameter by 12 meters (41') in length with a gross weight of about 907 metric tons (1000 tons), will contain approximately 16,000 curies of radioactivity, and have a surface contact radiation exposure rate of approximately 2 mrem/hour. The package is currently located approximately 19 meters (63') below grade in the Reactor Enclosure. 7 refs., 1 fig.

30347 **(DOE/SSDP—0040) Implementation of site release criteria at Shippingport.** Eger, K.J.; Galgoul, M.J.; Carr, J.B. (USDOE Shippingport Station Decommissioning Project Office, PA). 1988. Contract AC06-84RL10421;AC06-76RL01857. 4p. (CONF-880601—26).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Criteria for the unconditional release of the site, and materials left thereon following decommissioning of the Shippingport Atomic Power Station (SAPS) Site were issued by the Department of Energy (DOE) in January 1987. The criteria were "100 mrem/year via the worst case scenario" and "ALARA."Subsequently, GE Nuclear Engergy, the Decommissioning Operations Contractor (DOC), generated a "Final Consolidated Implementation Plan." This document defined the scenarios by which the final dose would be calculated, the limiting conditions for the "As decommissioned" site and the methodology for demonstating the achievemnt of these conditions. The plan is being used concurrently with the decommissioning operations to demonstrate that the site will meet the criteria issued. 1 fig.

30348 **(DOE/SSDP—0041) Decontamination to achieve site release criteria.** Schulmeister, A.R. (General Electric Co., Shippingport, PA (USA)). 1988. Contract AC06-84RL10421;AC06-76RL01857. 8p. (CONF-880601—23).

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The Shippingport Station Decommissioning Project presented unique opportunities in the management and peformance of component and area decontamination to meet established site relese criteria. Decontamination activities were performed to meet the following overall project objectives (criteria): (1) internal decontamination of radioactively contaminated components to meet low specific activity (LSA) shipping limits; (2) reduction of component radiation levels to as low as reaonably achievable (ALARA) for subsequent dismantlement, packaging and off site disposal; (3) reduction of surface contamination to qualify steel structurals for unrestricted off site release; (4) reduction of surface contamination to qualify concrete structurals for unrestricted on site release. 4 refs., 1 tab.

30349 (EGG-M—05387) Microcomputer-based probabilistic risk assessment for nuclear power plant safety studies. Van Siclen, V.S.;Russell, K.D.;Sattison, M.B.;Stewart, H.D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 8p. (CONF-870669—3). NTIS, PC A; Q 02/MF A01;1; GPO Dep. Order Number DE88006804/JAW.

From Society of Women Engineers national convention; Kansas City, MO, USA (24 Jun 1987).

Probabilistic risk assessment (PRA) information in the analysis of safety issues pertaining to nuclear power plant systems has been underutilized in the past due to the large effort required to input the PRA data and to the large size of the computers needed to run PRA codes. The microcomputer-based Integrated Reliability and Risk Analysis System (IRRAS) and the System Analysis and Risk Assessment System (SARA), recently developed at the Idaho National Engineering Laboratory, have greatly enhanced the ability of nuclear power plant analysts to use PRA techniques in their decision-making and analysis of safety issues. IRRAS is a tool for modeling and analyzing systems reliability and risk that allows the analyst to create, modify, update, and reanalyze a plant PRA to keep the risk assessment current with the plant's configuration and operation. The PRA is created and edited using a graphical fault tree editor, which significantly enhances the speed and accuracy with which the PRA data can be manipulated. The SARA system, incorporating the PRA data input in IRRAS, is used to analyze safety issues in nuclear power plants. To simulate changes to plant systems, SARA users alter the failure rates of basic events of the plant system models. They then evaluate the significance of these changes through the calculation of the resultant core damage and accident sequence probabilities and importance measures. IRRAS and SARA demonstrate that reliability and risk analysis studies of nuclear power plants, as well as of any other complex systems such as chemical plants or the space shuttle, can be performed very effectively on microcomputers, providing powerful and flexible tools for the safety analyst.

30350 (EGG-M—15287) An aging failure survey of light water reactor safety systems and components. MacDonald, P.E.; Satterwhite, D.G.; Meale, B.M.; Vora, J.P. (Idaho National Engineering Lab., Idaho Falls (USA); Nuclear Regulatory Commission, Rockville, MD (USA)). 1987. Contract AC07-76ID01570. 14p. (CONF-870604—4; IAEA-SM—295/36).

From International symposium on safety aspects of the aging and maintenance of nuclear power plants; Vienna, Austria (29 Jun 1987).

Operating experience data collection and evaluation are necessary to evaluate the effects of aging and degradation on the safety of operating nuclear power plants during their normal design life and any extended life. As a part of the Nulear Plant Aging Resarch (NPAR) program sponsored by the US Nulear Energy Commission, two unique types of data analysis were peformed. In the first, aging-related failure data from nine light water reactor safety, support, and power conversion systems have been extracted from an operational data base. systems and components within the systems that are most affectd by aging are identified. In the second analysis, iformation on aging-related Reported Causes of Failures has been extracted for components associated with the service water and Class 1E power distribution systems. The results of the work will help define future in-depth engineering studies of selected systems and components.

30351 (EGG-M—26887) The status of the TRAC-BWR [Transient Reactor Analysis Code for Boiling Water Reactors] program. Weaver, W.L. III;Johnsen, G.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 7p. (CONF-8710111—36).

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Transient Reactor Analysis Code for Boiling Water Reactors (TRAC-BWR) is being developed and maintained at the Idaho National Engineering Laboratory (INEL) for the Division of Accident Evaluation, Office of Nuclear Regulatory Research of the United States Nuclear Regulatory Commission (USNRC). The objective of this development is to provide the USNRC with a detailed, best estimate, efficient computer code for the analysis of postulated accidents and transients in boiling water reactor (BWR) systems. This program is unique among advanced code development projects in that it focuses on the hardware, thermal-hydraulics, and heat transfer phenomena that distinguish BWR systems and their response in transients. In addition to providing a best estimate analysis capability for BWR systems, the code can also be used to address current licensing concerns such as anticipated transients without scram (ATWS) or the small break loss-of-coolant accident (SBLOCA). It also provides analytical support to the USNRC experimental safety programs.

30352 (EGG-M—29987) Statistical evaluation of light water reactor piping damping data for use in PRA [probabilistic risk assessment] analyses. Ware, A.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 10p. (CONF-880661—5).

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

This paper presents the results of studies used to quantify, on a statistical basis, one of the parameters (piping system damping) input to probabilistic risk assessment (PRA) analyses of nuclear structures. Damping data were selected from tests in which the piping had been vibrated at levels representative of at least moderate severity seismic or hydrodynamic transients. Theses data, representing 27 light water reactor type piping systems, formed the basis for the statistical damping study. Most of these systems were actual nuclear power plant systems, and the lowest mode was < 8 Hz in over 80{percent} of the systems. Damping was treated as independent of frequency (or mode number). The statistical analysis showed that a lognormal probability fit provided a suitable approximation of the raw data. For the cases in which all data were considered (which allowed duplicate tests for each system to be included so that the overall data were biased by those systems with the most data), mean lognormal damping values ranged from 2.68{percent} to 3.55{percent} of critical. When duplicate tests were eliminated, the means ranged from 3.12{percent} to 3.72{percent} of critical. For the final cases, which considered only the lowest mode at its highest excitation level, mean lognormal damping values ranged from 3.28{percent} to 6.50{percent} of critical.

30353 (EGG-M—34887) Qualitative PRA insights for use in the design process for ALWRs. Leaver, D.E.; Krantz, E.A. (IT-Delian, San Jose, CA (USA)). 1988. Contract AC07-76ID01570. 10p. (CONF-880506—1).

From Safety of next generation power reactors; Seattle, WA, USA (1 May 1988).

A method has been developed for identifying and classifying qualitative design insights from probabilisitc risk assessments and related studies that should be considered in the design of advanced light water reactors. These qualitative design insights may be used in the preliminary design stage when the lack of design detail makes it difficult to perform quantitative risk analysis. These insights are easily accessible thorugh use of a microcomputer-based data base system and may be used to provide designers with risk-related "lessons learned" from existing plant system designs.

30354 (EGG-M—38086) Natural circulation cooling during a small-break loss-of-coolant accident in a simulated pressurized water reactor. Loomis, G.G.; Larson, T.K.; Streit, J.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 35p. (CONF-871275—2).

From ASME international symposium on natural circulation; Boston, MA, USA (17 Dec 1987).

This paper presents experiment results from a simulated small-break loss-of-coolant accident (SBLOCA) involving natural circulation core heat rejection mechanisms. The experiment results are compared to pre-experiment RELAP5/MOD2 calculations, and finally are related to expected pressurized water reactor (PWR) behavior during SBLOCA conditions. The simulation conducted in the Semiscale MOD-2C scaled-experiment facility was a 0.5% cold leg centerline break performed at high temperature and pressure with initial conditions typical of a PWR (15.6-MPa pressure, 587-K hot leg fluid temperature). The Semiscale MOD-2C facility represents all major components of a large PWR; the facility includes active loops, steam generators, and a vessel with an electrically heated core. The transition from forced circulation to the various

modes of natural circulation was characterized in the Semiscale simulation. The natural circulation cooling modes obseved include single-phase, two-phase, and reflux. Analysis included extensive decoupling of natural circulation heat rejection modes between the loops, and multi-dimensional effects within the steam genertor U-tubes. Comparison of RELAP5/MOD2 calculations with data shows correct qualitative calculation of the occurrence of single-phase, two-phae, and reflux cooling during the Semiscale transient. Analysis of similitude criteria for the Secmiscale facility suggests that the Semiscale results preserve the first order effects thought important for natural circulation phenomena expected in a PWR.

30355 **(EGG-SSRE—7899-Rev.1) A scoping study of fission product transport from failed fuel during N Reactor postulated accidents.** Hagrman, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1988. Contract AC07-76ID01570. 111p.

This report presents a scoping study of cesium, iodine, and tellurium behavior during a cold leg manifold break in the N Reactor. More detail about fission product behavior than has previously been available is provided and key parameters that control this behavior are identified. The LACE LA1 test and evidence from the Power Burst Facility Severe Fuel Damage tests are used to test the key model applied to determine aerosol behavior. Recommendations for future analysis are also provided. The primary result is that most of the cesium, iodine, and tellurium remains in the molten uranium fuel. Only 0.0035 of the total inventory is calculated to be released. Condensation of the most of the species of cesium and iodine that are released is calculated, with 0.998 of the released cesium and iodine condensing in the spacers and upstream end of the connector tubes. Most of the tellurium that is released condenses, but the chemical reaction of tellurium vapor with surfaces is also a major factor in the behavior of this element.

30356 **(EGG-TFM—7891) Simulation of cold leg manifold break and station blackout sequences in the N Reactor.** Bolander, M.A.; Fletcher, C.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 124p.

This report contains 2 microfiche supplement MF reduction factor 48 X.

This report documents work performed at the Idaho National Engineering Laboratory (INEL) in support of the Westinghouse Hanford Company safety analyses of the N Reactor. This work included: (1) developing a RELAP5/MOD2 N Reactor model from information contained in an existing RETRAN model, (2) modifying the RELAP5/MOD2 computer code for simulation of reflood behavior in horizontal core channels, and (3) performing and analyzing RELAP5/MOD2 transient calculations simulating N Reactor response during two hypothetical accidents. 9 refs., 52 figs., 4 tabs.

30357 **(EGG-TFM—7938) N Reactor RELAP5 model benchmark comparisons.** Fletcher, C.D.; Bolander, M.A. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 46p.

Includes 2 sheets of 48x reduction microfiche.

This report documents work performed at the Idaho National Engineering Laboratory (INEL) in support of Westinghouse Hanford Company safety analyses for the N Reactor. The portion of the work reported here includes comparisons of RELAP5/MOD2-calculated data with measured plant data for: (1) a plant trip reactor transient from full power operation; and (2) a hot dump test performed prior to plant startup. These qualitative comparisons are valuable because they provide an indication of the capabilities of the RELAP5/MOD2 code to simulate operational and blowdonw transients in the N Reactor. 9 refs., 12 figs., 4 tabs.

30358 **(EPRI-NP—5743) Loose-parts monitoring system improvements: Final Report.** Mayo, C.W.; Bozarth, D.P.; Lagerberg, G.N.; Mason, C.L. (Science Applications International Corp., Lynchburg, VA (USA)). Mar 1988. 185p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920266/JAW.

Metal impact theory and experimental data were used to develop an analytical basis for loose part monitoring system performance. Valid signal properties were defined and guidelines developed for the number and location of sensors, sensor mounting, calibration, signal filtering, surveillance, and signal interpretation. The supporting methods and data were documented for further use. These methods and guidelines provide a technical basis for identifying and implementing loose part monitoring system improvements. This report provides the final results for EPRI project RP2642-1.

30359 **(FhG-W—3/87) Possible use and limits of probabilistic models in connection with the reliability of large-scale plant. Final report.** Schmitt, W.; Baudendistel, E.; Ockewitz, A. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Mar 1987. 60p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753537/JAW.

The OCA-P program makes the deterministic and probabilistic safety analysis of reactor pressure vessels possible. The special routines in OCA-P for calculating the stress intensity factors are replaced by inherent developments. These methods permit the treatment of general fault and container geometries. The plot of the OCA-P was converted to the CALCOMP format. The checking was done by calculating examples with the original version and fictional examples of German plants (HDR). (DG) With 13 refs., 3 tabs., 46 figs..

30360 **(GEND-INF—078) ICBC Version 3.1: TMI-2 [Three Mile Island] Initial and Boundary Conditions data base.** Brower, R.W.; Fackrell, L.J.; Golden, D.W.; Harris, M.L.; Olaveson, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1988. Contract AC07-76ID01570. 154p.

The TMI-2 initial and boundary conditions data base is a micro computer data base which provides the required initial and boundary conditions to simulate the TMI-2 accident. Additionally, other time series plant measurements related to the accident are included in the data base. Major features of the data base are the ability to plot, manipulate and list data as well as to enter user supplied data (e.g. results of simulations). The user guide provides the instructions for installation and operation of the data base. 10 refs., 21 figs.

30361 **(INIS-mf—11175) Analysis of a pressurizer relief valve accident for WWER-440 reactors.** Marinov, M.; Samardzhiev, A. (Energoproekt, Sofia (Bulgaria)). 1984. 6p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702355/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A variant of an accident with the pressurizer relief valve of Sempel type for a WWER-440 reactor is considered. The RELAP4/MOD6 code is used to simulate the primary circuit behaviour during the accident. It is assumed that only the automatic safety and control systems respond to the disturbance and there is no operator action. The purpose of the study is to determine the critical moments for the core and primary circuit components and the key parameters to be analyzed in case of emergency for adequate operator response. Simulation results indicate that: (i) the minimal coolant flow rate reached during the first 3000 s of the transient is 320 kg/s, (ii) thermal conditions of the fuel elements and CHF ratio for an average channel are within the admissible tolerance; (iii) when two ECC pumps are in operation (switched on at 10.3 MPa, 34 s) the two-phase mixture level at 3000 s nearly reaches the hot leg. Switching off the ECC pumps causes a rapid increase in the core and upper plenum void fraction and a decrease in the upper plenum fluid level, due to the loss of coolant, which may lead to a core dry up.

30362 **(Juel—2159) Investigations of the effect of total pressure on the graphite/steam reaction in the in-pore diffusion controlled regime in connection with water ingress accidents in high-temperature reactors.** Loenissen, K.J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung; Technische Hochschule Aachen (Germany, F.R.)). Sep 1987. 171p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753572/JAW.

Experiments on the kinetics of the reaction of water vapor with HTR graphite are described. Two graphites were examined: the fuel element matrix material A3-27 and V483-T2 developed for core support structures. The experiments were carried out in the in-pore-diffusion controlled regime at total gas pressure between 3 and 55 bar. The results indicate that for V483-T2 the pressure dependence of the reaction rate can be described fairly well by the $1/\sqrt{p}$-relation. For matrix materials, however, this does not apply for the whole pressure range valid for water ingress accidents in an HTR. In the region where KNUDSEN-diffusion significantly influences the diffusion of the oxidants in the pore system of the graphite, an extrapolation of kinetic data which are rather easily measured at low pressures, is not valid. Such an extrapolation of low pressure data to pressures above approximately 15 bar would give values that are too low. This result is supported by calculations which were carried out using results of diffusion experiments on corroded graphites.

30363 **(NUREG/CR—4778) Preliminary studies of the morphology of thermal gradient tube deposits from fission product release experiments.** Wisbey, S.J. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 55p. (ORNL/TM—10273).

Sections of thermal gradient tubes and deposits from filters that were used as collectors in several fission product release tests at Oak Ridge National Laboratory have been examined by scanning electron microscopy with elemental identification by energy dispersive X-ray analysis. The shape, size, and composition of the deposits are reported; correlations with experimental conditions, s uch as gas composition and temperature, as well as with independent analyses, have been made where possible. A wide variety of shapes and structures, apparently dependent on the deposition temperature, were photographed, and elemental analyses were recorded. Although some fission products (Cs, Ba, Ag) were detected, structural and impurity elements (Sn, Si, S, W, Pt) were predominant in most cases. Recommendations for conducting analytical procedures and handling similar samples are made for the future. 14 refs., 22 figs., 3 tabs.

30364 **(NUREG/CR—5018) Uranium oxide--iron oxide mixed aerosol experiments in steam--air atmospheres: NSPP Tests 611, 612, 613, and 631, Data record report.** Tobias, M.L.;Adams, R.E. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 63p. (ORNL/TM—10588).

This data record report summarizes the results from three tests involving mixed aerosols of uranium oxide and iron oxide in a steam-air environment and one test in a dry environment. This research, sponsored by the US Nuclear Regulatory Commission, was conducted in the Nuclear Safety Pilot Plant at the Oak Ridge National Laboratory. The purpose of this project is to provide a data base on the behavior of aerosols in containment under conditions assumed to occur in postulated LWR accident sequences;this data base will provide experimental validation of aerosol behavioral codes under development. In the report, a brief description is given of each test together with the results in the form of tables and graphs. Included are data on aerosol mass concentration, aerosol fallout and plateout rates, total mass fallout and plateout, aerosol particle size, vessel atmosphere pressure, vessel atmosphere temperatures, temperature gradients near the vessel wall, and steam condensation rates on the vessel wall.

30365 **(NUREG/CR—5021-Vol.2) User's guide for PRISIM, Arkansas Nuclear One, Unit 1: Volume 2, Program for regulators.** Campbell, D.J.; Guthrie, V.H.; Kirchner, J.R.; Kirkman, J.Q.; Paula, H.M.; Ellison, B.C.; Dycus, F.M.; Farquharson, J.A.; Flanagan, G.F. (Oak Ridge National Lab., TN (USA); JBF Associates, Knoxville, TN (USA)). Mar 1988. Contract AC05-84OR21400. 220p. (ORNL/TM—10604-Vol.2).

This user's guide is a two-volume document designed to teach NRC inspectors and NRC regulators how to access probabilistic risk assessment information from the two Plant Risk Status Information Management System (PRISIM) programs developed for Arkansas Nuclear One - Unit One (ANO-1). This report, Volume 2, describes how the PRA information available in Version 2.0 of PRISIM is useful as an evaluation tool for regulatory activities. Using PRISIM, regulators can both access PRA information and modify the information to assess the impact these changes may have on plant safety. Each volume is a stand-alone document.

30366 **(NUREG/CR—5032) Modeling time to recovery and initiating event frequency for loss of off-site power incidents at nuclear power plants.** Iman, R.L.; Hora, S.C. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 59p. (SAND—87-2428).

Industry data representing the time to recovery of loss of off-site power at nuclear power plants for 63 incidents caused by plant-centered losses, grid losses, or severe weather losses are fit with exponential, lognormal, gamma and Weibull probability models. A Bayesian analysis is used to compare the adequacy of each of these models and to provide uncertainty bounds on each of the fitted models. A composite model that combines the probability models fitted to each of the three sources of data is presented as a method for predicting the time to recovery of loss of off-site power. The composite model is very general and can be made site specific by making adjustments on the models used, such as might occur due to the type of switchyard configuration or type of grid, and by adjusting the weights on the individual models, such as might occur with weather conditions existing at a particular plant. Adjustments in the composite model are shown for different models used for switchyard configuration and for different weights due to weather. Bayesian approaches are also presented for modeling the frequency of initiating events leading to loss of off-site power. One Bayesian model assumes that all plants share a common incidence rate for loss of off-site power, while the other Bayesian approach models the incidence rate for each plant relative to the incidence rates of all other plants. Combining the Bayesian models for the frequency of the initiating events with the composite Bayesian model for recovery provides the necessary vehicle for a complete model that incorporates uncertainty into a probabilistic risk assessment.

30367 **(NUREG/CR—5050) Annotated bibliography of reliability and risk data sources.** Hester, O.V.; Brown, S.R.; Gentillon, C.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1988. Contract AC07-76ID01570. 180p. (EGG-REQ—7827).

This document is an annotated bibliography of nuclear, nonnuclear, and foreign data sources that are useful in nuclear power plant reliability and risk analysis applications. A brief description of the contents, areas of usefulness, access information, and the name and address of a contact is provided for data sources of all types. In addition, for nuclear data sources, tabular comparisons are made. These comparisons include the scope of the data sources; their operational, special-purpose operational, pedigree, aggregated, and derived data; the operational and design data each data source originates from; and access information. Probabilistic risk assessments (PRAs) are profiled separately. For each PRA, background information that describes the PRA and the plant itself is provided. Also the input data sources used to support each PRA are identified. Of special interest is the identification of unique plant-specific data sources that have evolved from the PRA analyses. To the extent possible, how the data sources were used in the analysis is also discussed.

30368 **(ORNL/TM—10677) High Flux Isotope Reactor: Quarterly report, April through June 1987.** Corbett, B.L.; Farrar, M.B.; Shirley, E.M. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 16p.

The end-of-cycle 287 shutdown was begun on November 14, 1986, and extended indefinitely to investigate the embrittlement of reactor vessel materials due to radiation damage. This shutdown was extended through the second quarter of 1987. Activities at the High Flux Isotope Reactor (HFIR) during the quarter have cnetered on maintenance, calibration, and modification of reactor systems. Also, eleven recommendations for changes proposed by the Brinkerhoff committee for the HFIR restart were addressesd and action plans were developed to resolve these issues. 9 tabs.

30369 **(ORNL/TM—10678) High Flux Isotope Reactor: Quarterly report, July through September 1987.** Corbett, B.L.; Farrar, M.B.; Helton, C.H. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 18p.

The end-of-cycle 287 shutdown was begun on November 14,1986, and extended indefinitely to investigate the embrittlement of reactor vessel materials due to radiation damage. This shutdown was extended through the third quarter of 1987. Activities at the High Flux Isotope Reactor (HFIR) during the quarter have centered on maintenance, calibration, and modification of reactor systems. A hydrostatic pressure test of the HFIR primary coolant system was performed on August 4, 1987, to evaluate the integrity of the pressure vessel and to develop a basis for future reactor operations at 85 mw with 468 psig system pressure. A work stoppage declared in June by the Atomic Trades and Labor Council was continued throughout the quarter. Routine surveillance of the reactor facility was continued by qualified monthly personnel. Some maintenance and modification work was also continued by qualified craft supervisors. 9 tabs.

30370 **(PB—88-863188/XAB) Accident risks in nuclear facilities. January 1984-April 1988 (Citations from the NTIS data base). Report for January 1984-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 180p. NTIS PC N01/MF N01.

Supersedes PB—87-859286.

This bibliography contains citations concerning risk analysis and hazards evaluation of the design, construction, and operation of nuclear facilities, including the risk and hazards of transporting radioactive materials to and from these facilities. Radiological calculations for environmental effects of nuclear accidents and the utilzation of computer models in risk analysis are also included. (This updated bibliography contains 368 citations, 104 of which are new entries to the previous edition.)

30371 **(SAND—87-2522C) Physical modelling of the in-vessel phases of severe reactor accidents: The MELPROG/TRAC computer code.** Camp, W.J.; Tomkins, J.L.; Heames, T.J.; Dearing, J.F. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880309—3; IAEA-SM—296/97).

From International symposium on severe accidents in nuclear power plants; Sorrento, Italy (21 Mar 1988).

The MELPROG/TRAC computer code is the USNRC's bes-estimate model for analysis of phenomena in the rector vessel and reactor coolant system associated with the progression of severe accidents in light water reactors. Although versions exist for both boiling water reactors and pressurized water reactors, we confine our discussion herein to the pressurized water reactor. The structure of MELPROG/TRAC will be briefly summarized, its capabilities will be outlined, and results from typical analyses will be noted. As a specific example, differences in the initiation phase of a station blackout accident caused by pump seal failures will be described. finally, the experimental and analytical efforts to assess the modelling basis for MELPROG/TRAC will be outlined.

30372 **(SAND—88-0837C) Liquid metal reactor applications of the CONTAIN code.** Carroll, D.E.;Bergeron, K.D.;Gido, R.;Valdez, G.D.;Scholtyssek, W. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos National Lab., NM (USA); Technadyne Engineering Consultants, Inc., Albuquerque, NM (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). [1988]. Contract AC04-76DP00789. 7p. (CONF-880532—8).

From American Nuclear Society topical meeting; Seattle, WA, USA (1 May 1988).

The CONTAIN code is the NRC's best-estimate code fo the evaluation of the conditions that may exist inside a reactor containment building during a severe accident. Included in the phenomena modeled are thermal-hydrulics, radiant and convective heat transfer, aerosol ioading and transient response, fission product transport and heating effects, and interactions of sodium and corium with the containment atmosphere and structures. CONTAIN has been used by groups in Japan and West Germany to assess its ability to analyze accident consequences for Liquid Metal Reactor (LMR) plants. In conjuction with this use, collaborative efforts to improve the modeling capabilities of CONTAIN for LMR applications have been pursued. This paper summarizes the current state of the version of CONTAIN that has been enhanced with extra capabilities for LMR applications. A brief description of physical models is presented, followed by a short review of validation exercises performed with CONTAIN. Finally, some demonstration calculations of an integrated LMR application are presented. 11 refs., 5 figs.

30373 **(SAND—88-9672C) Interactions of radionuclide vapors with surfaces during transport through the reactor coolant system.** Powers, D.A.; Elrick, R.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 38p. (CONF-871236—5).

From Workshop on chemical processes and producers in severe reactor accidents; Captiva Island, FL, USA (9 Dec 1987).

This study determines that a decidedly more mechanistic flavor can be introduced into the modeling of radionuclide deposition and revaporization. This mechanistic modeling demands significantly more data than do simple, empirical models used in the past. The data requirements are both kinetic and thermodynamic in character. It appears that substantial strides can be made in assembling a base of thermodynamic data for most species of interest from information available in the literature. There will, however, remain significant uncertainties in these data. Where the uncertainties have a significant impact on the predictions for reactor accidents, it will be necessary to resolve the thermodynamic data to greater accuracy by experimental means. The greatest demand for experimental data will arise, however, in the need for kinetic information about the heterogeneous reactions of vapors with condensed phases. To date the available data base for these heterogeneous reactions kinetics is very sparse and in most cases may not deal with the species expected on thermodynamic grounds to be the predominany contributors to radionuclide deposits in the reactor coolant system.

30374 **(SKI—86006) Investigations of the BISON computer code - verification against test data.** Eriksson, S.O.; Rundstroem, T. (Energiteknisk Utveckling AB, Trosa (Sweden)). (Energiteknisk Utveckling AB, Trosa (Sweden); Swedish Nuclear Power Inspectorate, Stockholm). 16 Jun 1986. 32p. (In Swedish). (ETU—6005-01). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753025/JAW.

The BISON computer code is applied to predict the course of events in boiling water reactors at possible incidents, such as rapid valve-closures or coolant-flow disturbances. These predictions are regarded as an accepted form of transient analyses for BWRs designed by ASEA-ATOM. The Swedish Nuclear Power Inspectorate has commisioned ETU AB to investigate the ability of the BISON code to predict measured data from three experimental tests and five reactor transient tests. Static dryouts were predicted with use of the AA-74 dryout-correlation in the BISON code for dryout-experiments carried out in the test loops FIX-I, Atlas and FIX-II. Conservative predictions of FIX-I and Atlas test results were made by using the AA-74 correlation including an 'exit quality'-part. The predictions of FIX-II results were not conservative in all investigated cases, especially not for test cases with minor coolant flows. The examination of the BISON verification concerning reactor transients is based in the main on transients of weaker kind than the design base transients. The BISON code is considered to have the capability of predicting dryout margins with a small degree of conservatism for BWR transients and is also considered to be an appropriate tool for licensing calculations. However, it is essential for future calculations to make use of a documented standard version of the BISON code or a strict pattern of code options and input parameter sets for representative transient-analysis cases. This standard BISON code or strict pattern has to be additionally verified by predicting experimental results, well-suited for this verification purpose. (authors).

30375 **(TPR-NS—29-No.1, pp 1-5) Core history and nuclide inventory of the Chernobyl core at the time of accident.** Kirchner, G.; Noack, C.C. (Univ. of Bremen (West Germany)). 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

Activity ratios found in burnt nuclear fuel are characteristic of burnup and decay time after shutdown of a reactor. Cs-134/Cs-137, Cs-136/Cs-137, and Te-129/Te-132 activity ratios established for the Chernobyl fallout are compared with those calculated for different burnups by using the code system SAS 2(UHB)/ORIGEN-S(UHB). The measured activity ratios in fallout correspond to a calculated mean burnup of 12.85 +/- 0.15 GWd/ton (core average). Surprisingly, they also indicate a shutdown of the plant between 3 and 5 days before the accident occurred. The inventories of important radionuclides at the time of accident are calculated for the determined burnup and decay period of the core.

30376 (TPR-NS—29-No.1, pp 6-20) **Nonprescriptive nuclear safety regulation: example of loss of offsite power.** Golay, M.W.; Manno, V.P.; Vlahoplus, C. Jr. (Massachusetts Institute of Technology, Cambridge (USA)). 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

The US approach to nuclear safety regulation has been criticized as highly prescriptive, burdensome, and unpredictable - much more so than are such systems in other countries. The work reported here illustrates the feasibility and potential benefits of an alternate, nonprescriptive approach to nuclear safety regulation. In the example investigated, a nonprescriptive regulation for treatment of the problem of loss of offsite power at a pressurized-water reactor is formulated, and its implementation in a set of power-station cases is explored. The results of this work have been reviewed by representative groups from the US nuclear power industry and the Nuclear Regulatory Commission. The responses indicate a consensus that nonprescriptive regulation would be beneficial and that the exercise summarized in this article represents a credible first step toward its realization. Nevertheless, there remain significant reservations concerning specific aspects of implementation, such as those involving data-base manipulation, uncertainty, and the standardization of assessment methods. The extension of the work reported here to treatment of the full range of issues encountered in regulation of an entire power station would be necessary before the complete case for use of nonprescriptive regulation could be established.

30377 (TPR-NS—29-No.1, pp 20-28) **Nuclear power safety goals in light of the Chernobyl accident.** Whipple, C.; Starr, C. (Electric Power Research Institute, Palo Alto, CA (USA)). 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

The recently adopted Nuclear Regulatory Commission safety goals include a proposed plant performance guideline limiting the frequency of large releases of radioactive materials. Analysis indicates that the proposed plant guideline is potentially far more restrictive than the health objectives, goes well beyond previously established health objectives, and is not supported on cost-benefit grounds. The Chernobyl accident, which caused no offsite prompt fatalities, has cast doubt on the operational significance of the safety goal health objectives. The proposed guideline is responsive to concerns that the health objectives do not limit the frequency of accidents sufficiently.

30378 (TPR-NS—29-No.1, pp 29-35) **Containment loads from severe accidents: US program.** Kerr, W.; Dey, M.K. (Univ. of Michigan, Ann Arbor (USA)). 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

After the accident at the Three Mile Island Nuclear Station, the Nuclear Regulatory Commission (NRC) undertook research to reevaluate the risk from severe accidents in nuclear power plants. Because containment behavior is an important part of plant risk assessment, it is especially important in determining the likelihood of early containment failure, which might result in large releases of radioactive material. Therefore a significant portion of the research has been the reassessing of source terms. Both NRC and the US nuclear industry are refining the analytical models used for severe accident analysis in an effort to decrease uncertainties. This article describes the results of research on the major loads for US containments and the present status of the related analytical methods.

30379 (TPR-NS—29-No.1, pp 36-48) **Safety characteristics of modern high-temperature reactors: focus on German designs.** Kroeger, W.; Nickel, H.; Schulten, R. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

This article describes the safety characteristics of high-temperature gas-cooled reactors, particularly those of German designs. It discusses safety-related properties, fuel-element design and fission-product barriers, reactor behavior under loss of active core-cooling conditions, results of safety analyses, and the safety concept of modern German designs. 22 references.

30380 (TPR-NS—29-No.1, pp 67-84) **Operating US power reactors.** Silver, E.G. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

This update, which appears regularly in each issue of Nuclear Safety, surveys the operations of those power reactors in the US which have been issued operating licenses. Table 1 shows the number of such reactors and their net capacities as of September 30, 1987, the end of the three-month period covered in this report. Table 2 lists the unit capacity and forced outage rate for each licensed reactor for each of the three months (July, August, and September 1987) covered in this report and the cumulative values of these parameters since the beginning of commercial operation. In addition to the tabular data, this article discusses other significant occurrences and developments that affected licensed US power reactors during this reporting period. Status changes at Braidwood Unit 1, Nine Mile Point 2, and Beaver Valley 2 are discussed. Other occurrences discussed are: retraining of control-room operators at Peach Bottom; a request for 25% power for Shoreham, problems at Fermi 2 which delayed the request to go to 75% power; the results of a safety study of the N Reactor at Hanford; a proposed merger of Pacific Gas and Electric with Sacramento Municipal Utility District which would result in the decommissioning of Rancho Seco; the ordered shutdown of Oyster Creek; a minor radioactivity release caused by a steam generator tube rupture at North Anna 1; and 13 fines levied by the NRC on reactor licensees.

30381 **Prospects for inherently safe reactors.** Barkenbus, J.N. (Oak Ridge Associated Universities, Inc., TN (USA). Inst. for Energy Analysis). *Energy Policy;* **16**: No. 1, 49-57(Feb 1988).

Public fears over nuclear safety have led some within the nuclear community to investigate the possibility of producing inherently safe nuclear reactors; that is, reactors that are transparently incapable of producing a core melt. While several promising designs of such reactors have been produced, support for large-scale research and development efforts has not been forthcoming. The prospects for commercialization of inherently safe reactors, therefore, are problematic; possible events such as further nuclear reactor accidents and superpower summits, could alter the present situation significantly.

30382 **Tellurium behavior in containment under light water reactor accident conditions.** Beahm, E.C. (Oak Ridge National Lab., Chemical Technology Div., P.O. Box X, Building 4501, Oak Ridge, TN 37831-6221 (USA)). *Nuclear Technology;* **78**: No. 3, 295-302(Sep 1987). Contract AC05-84OR21400.

Interactions of tellurium in containment can result in changes of physical form and therefore in its transport properties. The physical and chemical forms of inorganic tellurium species will be determined by condensation, oxidation, and dissolution in water. Of the three volatile tellurium chemical forms, Te_2 (gas, aerosol), H_2Te, and organic tellurides, only organic tellurides have the potential to remain in the gas phase in a containment atmosphere. There is a general lack of information on the formation and removal of organic tellurides under light water reactor accident conditions.

30383 **Experimental studies of fission product release from commercial light water reactor fuel under accident conditions.** Osborne, M.F.;Collins, J.L.;Lorenz, R.A. (Oak Ridge National Lab., Chemical Technology Div., P.O. Box X, Oak Ridge, TN 37831 (USA)). *Nuclear Technology;* 78: No. 2, 157-169(Aug 1987). Contract AC05-84OR21400.

Fission product release from fully irradiated light water reactor fuel under accident conditions and the chemical forms and behavior of the released material have been studied at high temperatures. This work has emphasized release from commercial fuels, but tracer-level tests using specific fission product species have been used in efforts to clarify chemical behavior. The specimens were heated in an induction furnace in flowing steam at temperatures of 1700 to 2300 K. The fractional releases of krypton, iodine, and cesium increased with temperature, reaching maxima of nearly 60% in 20 min. The release of tellurium varied strongly with the extent of cladding oxidation and approached that of cesium for completely oxidized cladding. In addition to some structural material, the major chemical forms in the furnace effluent appeared to include CsI, CsOH, silver, antimony, and tellurides of cesium and tin. The fractional releases of the volatile fission products correlated with the amount of fuel porosity, and the masses of aerosol collected increased with test temperature and oxidation. Comparison of our results with several fission product release models showed agreement ranging from good to poor.

30384 **Simulation-based expert system for nuclear-power-plant diagnostics.** Hassberger, J.A. Ann Arbor, MI; Univ. of Michigan (1986). 119p. University Microfilms Order No. 87-02,743.

Thesis (Ph. D.).

Applications of expert systems to the diagnostics of nuclear power plant accidents is considered. In this work, dynamic simulators, Kalman filtering, pattern recognition, fuzzy diagnostics and artificial intelligence are combined in a unique algorithm for diagnosing and analyzing nuclear plant transients targeted for use on-line and in real time. Knowledge-based reasoning is used to monitor plant data and hypothesize about the status of the plant. Fuzzy logic is employed as the inferencing mechanism and an implication scheme based on observations is developed and employed to handle scenarios involving competing failures. Hypothesis testing is performed by simulating the behavior of faulted components using numerical models. A simulation filter was developed based on the structure of the Kalman filter for systematically adjusting key model parameters to force agreement between the simulation and actual plant data. The unique feature of the simulation filter is that it operates only on the discrete time-series of inputs and associated outputs of a dynamic simulation program, thus admitting arbitrary system dynamics and being readily applicable to any system for which a simulation program for computing system states is available. Detailed simulation results of various nuclear power plant accident scenarios are presented to demonstrate the performance and robustness properties of the diagnostic algorithm developed.

25 ENERGY STORAGE

2502 Compressed Gas

30385 **(EPRI-AP—5689) Low-porosity rock cavern design concepts for compressed-air energy storage: Final report.** Lindblom, U.E. (Lindblom (U.E.), Goeteborg (Sweden)). Mar 1988. 137p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920233/JAW.

Compressed air energy storage systems (CAES) require that substantial storage volumes can be created underground. In hard rock geologies, rock caverns can be mined to store the air. This report mainly deals with unlined cavern concepts, in particular, caverns without water compensation. In this concept, the air pressure will be variable. Turbomachineries with constant and variable inlet pressure designs for use with uncompensated caverns are discussed in the report. Compensated caverns are used as reference. The report also discusses various principles of constructing large caverns for CAES. In this context, traditional as well as some new mining techniques are described. Conceptual layouts for various CAES plant sizes are selected for economic evaluation. The report also provides a comprehensive evaluation of geotechnical aspects associated with highly compressed gas in hard rock caverns. 30 refs., 46 figs., 13 tabs.

2506 Thermal

REFER ALSO TO CITATION(S) 30210, 30474, 31277

30386 **(PB—88-861620/XAB) Phase change materials. January 1970-March 1988 (citations from the US Patent data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 51p. NTIS PC N01/MF N01.

Supersedes PB—685-862373.

This bibliography contains citations of selected patents concerning the use of phase-change materials in thermal-energy-storage systems and energy utilization. Phase change compositions used in solar-energy-building heating and cooling systems are discussed, as well as methods used in the preparation of thermal storage materials. (This updated bibliography contains 87 citations, 18 of which are new entries to the previous edition.)

30387 **(PNL-SA—15449) Field experience with aquifer thermal energy storage.** Kannberg, L.D. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 15p. (CONF-880212—6).

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

Aquifer thermal energy storage (ATES) has the potential to provide storage for large-scale building heating and cooling at many sites in the US. However, implementation requires careful attention to site geohydraulic and geochemical characteristics. Field tests in the US have shown the over 60% of the heat injected at temperatures over 100{degree}C can be recovered on a seasonal cycle. Similarly, aquifer storage of shilled ground water can provide building cooling with annual cooling electrical energy reductions of over 50% and a reduction in summer peak cooling electrical usage by as much as a factor of 20. A number of projects have been built and operated around the world. China has installed numerous ATES systems in many major cities. Installations in QEurope and Scandinavia are almost exclusicely low-temperature heat storage systems that use heat pumps. Two high-temperature systems (over 100{degree}C are in operation or undergoing preliminary testing: one in Denmark, the other in France. Heat ATES often requires water treatment to prevent precipitation of calcium and magnesium carbonates. At some sites, consideration of other geochemical and microbiological issues (such as iron bacteria) must be resolved. 7 refs.

2509 Batteries

REFER ALSO TO CITATION(S) 30516, 30799

30388 **(AD-A—189274/4/XAB) Electrochemical and spectroscopic study of electrode systems. Final report, May 1986-January 1987.** Keil, R.G.; Sinha, S.P. (Dayton Univ., OH (USA). Research Inst.). Sep 1987. 54p. NTIS, PC A04/MF A01.

This final report concerns research in the area of electrochemical and spectroscopic studies on electrode and electrolyte systems for use within nonaqueous battery systems from 1 May 1986 through 31 January, 1987. The research has as a unifying theme the use of electrochemical and spectroscopic methods in the pursuit of an understanding of the chemical processes which occur at the electrodes as well as within the solution phase. The work is divided into two distinct phases: (a) the study of imidazolium melts and (b) the electrochemical reversibility of lithium.

30389 **(AD-A—189288/4/XAB) Characterization of redox states of nickel hydroxide film electrodes by in-situ Raman spectroscopy. Technical report, 1 October 1986-30 September 1987.** Desilvestro, J.; Corrigan, D.A.; Weaver, M.J. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). 25 Sep 1987. 37p. (TR—65). NTIS, PC A03/MF A01.

Thin films of nickel hydroxide deposited on gold electrodes were characterized in detail by in-situ surface Raman spectroscopy in conjunction with electrochemical techniques. Raman spectra were obtained for film thicknesses varying from less than one equivalent monolayer to several hundred monolayers, as determined from the faradaic charge for the cyclic voltammetric oxidation of Ni(OH)2. For the thinnest films, Raman bands at 455/cm and at 480 and 560/cm were obtained for the reduced and oxidized films, respectively, using 647.1 nm excitation at roughened gold. These signals, identified with Ni-OH and Ni-O vibrations from deuterium isotope data, were diagnosed as arising from surface-enhanced Raman scattering (SERS) in view of their absence for the reduced film when using the latter conditions for thicker oxidized films, which were consistent with resonance Raman scattering (RRS).

30390 **(DOE/NBM—8006908) Development and evaluation of anode alloys for aluminum/air batteries: Final report.** Macdonald, D.; Real, S.; Urquidi-Macdonald, M. (SRI International, Menlo Park, CA (USA)). Feb 1987. Contract W-7405-ENG-48. 242p.

Experimental and theoretical studies are reported on the development of aluminum alloys for alkaline aluminumair batteries. This work begins by analyzing the thermodyanmics of aluminum in LiOH, NaOH, and KOH solutions as a function of concentration (0 to 7 molkg alkali) and temperature (25 to 100{degree}C). The thermodynamic data define the conditions under which precipitation of $Al(OH)_3$ may occur but, more importantly for this study, they yield equilibrium potentials for various charge transfer reactions, including aluminum dissolution, $Al(OH)_3$ and A100H formation, AlH_3 formation, oxygen reduction, and hydrogen evoltuion. These data are used in our mechanistic analyses of aluminum electrodissolution. The findings of this work form the basis of a working model for the activation of aluminum alloy fuels for alkaline aluminumair batteries, in which activation is attributed to the oxidative dissolution of a protective layer of metallic alloying elements (principally gallium) from the surface at a voltage of {approximately}1.5 V (HgHgO). This model is now being used to design and prepare new high energy density anodes for Alair batteris. 29 refs., 87 figs., 39 tabs.

30391 **(LBL—24295) All inorganic ambient temperature rechargeable lithium battery: Final report.** Kuo, H.C.; Dey, A.N.; Schlaikjer, C.; Foster, D.; Kallianidis, M. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 225p.

Having the advantages of high energy density and good charge retention, rechargeable lithium batteries have been of interest to many companies and research organizations within the last 15 years. Various lithium rechargeable systems with different positive electrodes and electrolytes have been reported in literature. Most are using electrolytes with organic solvents. Duracell Inc. has demonstrated the feasibility of using totally inorganic electrolytes based on liquid So_2 for the ambient temperature recharageable lithium battery. The system has lithium as the negative electrode and porous carbon as the positive electrode with SO_2 as the depolarizer and electrolyte solvent. A four year cost-shared joint program with the Department of Energy was initiated in October 1980 to investigate the SO_2-based electrolytes and to develop an ambient temperature rechargeable lithium battery for future energy storage applications. The ultimate goal of this program is to develop a battery having an energy density over 150 whkg with cycle life of 500 to 800 at 80 to 100% depth of discharge. During the four years, SO_2 electrolytes with various inorganic salts and various positive electrodes made of porous carbon and solid active materials were evaluated. Promising systems having good rechargeability and high energy density, such as $LiCuCl_2$ and $LiLiAlCl_4$-SO_2carbon were identified. Ths report summarizes the progress achieved in the program. 15 refs., 95 figs., 23 tabs.

30392 **(LBL—24647) Ambient temperature secondary lithium batteries using LiAl or lithium insertion anodes: Final report.** Abraham, K.M. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 40p.

The feasibility of using Li/sub x/Fe_2O_3, Li/sub x/WO_2 and β-LiAl as alternative anodes for ambient temperature secondary Li batteries was studied. A convenient procedure for the synthesis of these materials at normal temperature and pressure conditions has been developed. The electrochemical behavior of the alternative anode materials was studied in cells utilizing a TiS_2 cathode and PC-$LiC10_4$ electrolyte. While the lithiated oxides have exhibited good reversibility, their equivalent weights are too high for use in high energy density batteries. The experimentally determined value for the reversible Li capacity of Li/sub x/Wo_3 indicated an equivalent weight of 370 for this anode. The corresponding value for $Li_6Fe_2O_3$ was 201. The results obtained with the β-LiAl, synthesized by the new procedure, were too limited to draw meaningful conclusions regarding its usefulness in practical cells. Amorphous V_2O_5, Cr_3O_8 and Li/sub x/CoO_2 were evaluated as cathodes for possible use in conjunction with the alternative anodes. While the capacities of a-V_2O_5 and Cr_3O_8, of 2.4 LiV_2O_5 and 4.5 $LiCr_3O_8$, respectively, are attractive for practical applications, these positive electrodes exhibited rather low rate capabilities. The performance of Li/sub x/CoO_2 was inferior to the results previously reported for the cathode and might have been influenced by the electrolyte employed in our studies. 17 refs., 19 figs., 4 tabs.

30393 **(LBL—24788) Electrocatalysts for oxygen electrodes: Final report.** Yeager, E. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 123p.

The performance of low and moderate temperature fuel cells and reehargeable metal-air batteries is limited by the catalytic activity and life of the O_2 electrocatalysts. The overall objective of this research has been the development of much more effective electrocatalysts for O_2 reduction and generation, combining high catalytic activity with long-term stability in concentrated acid and alkaline electrolytes. Research emphasis is on achieving a fundamental understanding of O_2 electrocatalysis. 76 refs., 53 figs., 6 tabs.

30394 **(SAND—87-1136C) Optimization of reserve lithium thionyl chloride battery electrochemical design parameters.** Doddapaneni, N.; Godshall, N.A. (Honeywell, Inc., Horsham, PA (USA). Power Sources Center; Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-871027—46).

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

The performance of Reserve Lithium Thionyl Chloride (RLTC) batteries was optimized by conducting a parametric study of seven electrochemical parameters: electrode compression, carbon thickness, presence of catalyst, temperature, electrode limitation, discharge rate, and electrolyte acidity. Increasing electrode compression (from 0 to 15%) improved battery performance significantly (10% greater carbon capacity density). Although thinner carbon cathodes yielded less absolute capacity than did thicker cathodes, they did so with considerably higher volume efficiencies. The effect of these parameters, and their synergistic interactions, on electrochemical cell peformance is illustrated. 5 refs., 9 figs., 3 tabs.

30395 **(SAND—88-0276C) An overview of advanced battery development at Sandia National Laboratories.** Murphy, K.D.;Diegle, R.B. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 24p. (CONF-880325—1). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006823/JAW.

From 2. international rechargeable battery seminar; Deerfield Beach, FL, USA (7 Mar 1988).

This paper contains a description of the activities of Sandia National Laboratories directed towards the development of electric battery technology. Batteries being developed have applications in electric powered vehicles, utility load leveling, and solar electric energy storage. General design points, recent achievements, and some applications of the work at Sandia is mentioned. 1 ref., 4 figs., 1 tab. (JDH)

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 30476

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 29946, 30436, 30512, 31974

30396 (CONF-8605117—, pp 165-166) **Impact of the Soviet nuclear disaster at Chernobyl on energy planning.** Comtois, W.H. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the energy shortages faced in portions of the US and the economic instability that these areas are facing in the wake of several nuclear accidents. The resulting public controversy has lead to more conventional sources of energy such as coal, oil, and gas. The acid rain question has created more controversy, placing the US back into oil and gas reserves which are undependable. The paper discusses these problems on energy planning and rate fixing. The author also presents recommendations on restoring rationality to energy planning. These include removing uncertainty of investment by regulators; remove uncertainty of rate making; remove uncertainty of permitting and licensing; remove the threat of acid rain legislation until more facts are known; and promote research into means of utilizing coal while avoiding environmental damage.

30397 (DOE/IE/10521—T3) **Australia: An energy sector study.** Hoffman, S. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Mar 1988. Contract FG01-86IE10521. 298p.

As part of our continuing assessment of the Asia-Pacific energy markets, the Energy Program has embarked upon a study of Australia that discusses in detail the structure of the energy sector within the region. The study also provides the reader with an overview of the economic situation and, when possible, of the political situation. We have particularly highlighted petroleum and gas issues and have attempted to show the foreign trade implications of oil and gas trade. Finally, as much as possible, we have provided the latest available statistics - more often than not, from unpublished sources. Staff members have traveled extensively in the country under review and have spoken to top policymakers in government and industry. Thus, these reports provide not only information but the latest thinking on energy issues in various countries. 23 figs., 82 tabs.

30398 (PB—88-187331/XAB) **Overview of the US pulp and paper industry. Topical report. Volume 1. Report for February 1985-October 1986.** Canty, C.; Machacek, R.; Kusik, C.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1988. 144p. NTIS, PC A07/MF A01.

See also Volume 2, PB—88-187349.

To develop background material on the dynamics of the pulp and paper industry, its products, markets, technological characteristics and energy use, this study focused on industry segments classified in SIC 261, 262, and 263, which together account for an estimated 89% of energy use in the pulp and paper industry. Although design modifications will occur, no major technological developments are anticipated. Demand for paper products is expected to grow at a rate somewhat lower than that of the GNP. Growth in energy consumption will track this industry's growth, with a large portion (about 50%) met by wood waste or other byproduct fuels. The nonintegrated paper producers rely almost wholly on purchased fuels, and this segment--using only 12% of the industry's total energy--amounts to about 275 trillion Btu per year. Natural gas is expected to maintain market share in the pulp and paper industry, depending on pricing. To ensure adoption by industry, new gas-based technologies must answer two demands: (1) lower the cost of production and (2) enhance or maintain product quality.

30399 (PB—88-187349/XAB) **Overview of the US pulp and paper industry. Topical report. Volume 2. Report for February 1985-October 1986.** Canty, C.; Machacek, R.; Kusik, C.L. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Jan 1988. 260p. NTIS, PC A12/MF A01.

See also Volume 1, PB—88-187331.

To develop background material on the dynamics of the pulp and paper industry, its products, markets, technological characteristics and energy use, this study focused on industry segments classified in SIC 261, 262, and 263, which together account for an estimated 89% of energy use in the pulp and paper industry. Although design modifications will occur, no major technological developments are anticipated. Demand for paper products is expected to grow at a rate somewhat lower than that of the GNP. Growth in energy consumption will track this industry's growth with a large portion (about 50%) met by wood waste or other byproduct fuels. The nonintegrated paper producers rely almost wholly on purchased fuels, and this segment--using only 12% of the industry total energy--amounts to about 275 trillion Btu per year. Natural gas is expected to maintain market share in the pulp and paper industry, depending on pricing. To ensure adoption by industry, new gas-based technologies must answer two demands: (1) lower the cost of production and (2) enhance or maintain product quality.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 29842, 29843, 29862, 29975, 29976, 30055, 30173, 30175, 30186, 30224, 30226, 30253, 30396, 30397, 30418, 30419, 30422, 30423, 30424, 30425, 30426, 30427, 30428, 30429, 30433, 30439, 30447, 30487, 31974

30400 (ANL/EES-TM—341) **Disemployment effects caused by regulation of drilling fluids and produced waters as hazardous under the Resource Conservation and Recovery Act.** Flaim, S.J. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 19p.

This report reviews and compares several studies of the effects on employment of regulating wastes from oil and natural gas exploration and extraction under the Resource Conservation and Recovery Act (RCRA). The waste management scenarios on which most of the studies were based were developed by the U.S. Environmental Protection Agency. The analyses show that as many as 500,000-700,000 jobs may be lost in the first year if RCRA Subtitle C rules are applied to drilling fluids and produced waters. As a results, unemployment in major oil-producing states could rise by as much as six percentage points. 13 refs., 4 tabs.

30401 (CONF-880485—1) **Foreign trade, the multinational enterprise, and regional economic change in the United States: Issues for locational analysis.** Jones, D.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007678/JAW.

From Workshop on analytical economic geography and regional economic change; Phoenix, AZ, USA (6 Apr 1988).

This paper identifies the scope for locational analysis - regional and spatial economics, or in general, economic geography - to contribute to the assessment of the role of international trade and the multinational enterprise activity in changing the regional pattern of economic activity in the United States. Recent trends in actual trade patterns and in the theory of trade and the multinational enterprise are reviewed. The increasing prominence of intraindustry trade has prompted further development in trade theory, while changes in the theory of the multinational enterprise (MNE) have been hard pressed to keep up with changes in MNE activity. Empirical research suggests tentatively that the full employment impacts of the recent American trade deficit have been distributed more evenly across census regions than is commonly believed. There has been little empirical research on the regional impacts of MNEs in the United States, although considerably more has been done in the British Isles;much of this has been little guided by economic theory of the MNE or by location theory. Opportunities for regional/spatial analysis of foreign trade lie in spatial assessment of comparative advantage. The spatial version of industrial organization theory, spatial pricing/spatial competition theory (SP/SC), has

been used in limited analysis of issues in MNE activity, and there appear to be opportunities for extension of SP/SC modeling into issues of informational asymmetry that could bear on MNE choices. Additionally, locational modeling of integrated, multi-plant firms could offer insights into certain aspects of MNE operational behavior. Studies of the regional impacts of MNE activity in the United States, or in other countries, needs to take better account of the branch plant as a member of a multi-plant firm in a noncompetitive industry than has been done to date.

30402 **(DOE/IE/10521—T1) Taiwan: An energy sector study.** Johnson, T.; Fridley, D.; Kang, Wu. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Mar 1988. Contract FG01-86IE10521. 147p.

A study on the economy of Taiwan, with special reference to the energy sector, revealed the following: Taiwan's rapid export-driven economic growth in the 1970s and 1980s has earned them the rank of "Newly Industrialized Countries." Coal reserves measure less than 1 billion tons, and annual output has declined to below 2 million tons per year. Marginal amounts of crude are produced. Natural gas resources have been exploited both on- and offshore, through production amounts to little more than 1 billion cubic meters per year. Domestic hydrocarbon production is forecast to decline. Taiwan prssesses an estimated 5300 mW of exploitable hydropower capacity, of which 2564 mW had been installed by 1986. Taiwan has undertaken a massive program of nuclear power construction in response to the rapid rise in oil prices during the 1970s. Energy demand has risen an average of 9.0 percent per year since 1954, while real GNP has grown 8.6 percent per year. Sine 1980, oil has provided a lower share of total energy demand. Oil demand for transport has continued to grow rapidly. Declining production of domestic natural gas has led Taiwan to initiate LNG imports from Indonesia beginning in 1990. Coal has regained some of its earlier importance in Taiwan's energy structure. With declining domestic production, imports now provide nearly 90 percent of total coal demand. Taiwan is basically self-sufficient in refining capacity. Energy demand is expected to grow 5.4 percent per year through the yeat 2000. With declining output of domestic resources, energy dependency on imports will rise from its current 90 percent level. Government policy recognizes this external dependency and has directed it efforts at diversification of suppliers. 18 refs., 11 figs., 40 tabs.

30403 **(DOE/IE/10521—T2) Singapore: An energy sector study.** Doshi, T. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Mar 1988. Contract FG01-86IE10521. 166p.

A study of Singapore's economy with special reference to the energy sector, revealed the following: Singapore has no domestic energy resources, no coal-handling infrastructure or gas-import system. It relies wholly on imported petroleum for its energy supply. Singapore is currently negotiating gas-supply arrangements with Malaysia and Indonesia, primarily for use in the electric-power sector. As a percentafe of demand, Singapore is one of the world's largest consumers of fuel oil. Proposed gas imports could have a substantial impact on the present pattern of energy demand. Energy consumption amounts to 40 percent of its energy imports; the bulk of energy imports are re-exported, either after further processing after temporary storage. Since refiners must face the external market as their primary outlet for products, government policy has only a minimal effect on the economics of refining. Singapore's domestic oil market is one of the world's most reponsive in terms of following world market conditions; the degree of government interference in the refining sector is comparable to that seen in the United States. Although Singapore refining actually contracted following the 1979 price increases, Singapore's role in the world oil market has steadily expanded. The collapse of Singapore refining has been incorrectly predicted many times since 1973. The sophistication of Singapore's refining industry has traditionally been operational rather than technological. However, Shell, Esso, and Mobil plan major upgrading and cracking additions for completion in the early 1990s. This will increase Singapore's technical flexibiity to levels that compare favorably with Japan and most other Asian countrics and will help to ensure that Singapore will remain the center of the Asian-Pacific oil market into the foreseeable future. 31 refs., 1 fig., 13 tabs.

30404 **(PB—88-174289/XAB) Residential and commercial fuel prices in major US cities.** Brodrick, J.R.; Fay, J.M. (Gas Research Inst., Chicago, IL (USA)). Jul 1986. 15p. (GRI—86/0307). NTIS, PC A03/MF A01.

This report summarizes the results of a GRI-commissioned study to survey and compare residential and commercial fuel prices in 18 representative U.S. cities. Results show that although the 18 utilities in the sample offer a large number of different electric rates, most residential and commercial customers use the utilities' basic rate schedule. The residential electric rate structure generally varies seasonally, with block rates increasing in the summer cooling season. Commercial electric rate structures are more complicated, with separately metered demand charges typically offered in conjunction with a basic time-of-use rate. On the other hand, gas rates are simpler in structure for both residential and commercial customers. The gas rates offered are simple basic rates with either a flat rate or a declining block structure. Most gas rates do not vary seasonally; those that do vary reflect shifts in the fuel-cost adjustment between seasons. The survey also ranks the 18 cities by the average price of electricity in dollars per million Btu. The seasonal electric rates make electricity more competitive with natural gas during the winter heating season due to the low market-clearing prices. During summer, electricity competes effectively with natural gas despite the higher market price due to the limited cooling availability of natural gas.

30405 **Energy supply and use in developing countries: A fresh look at Western (OECD) interests and US policy options.** Gray, J.E.;Davis, W.K.;Harned, J.W. (eds.). Lanham, MD; University Press of America, Inc. (1988). 139p. (DOE/IE/10506—T2). University Press of America, Inc., 4720 Boston Way, Lanham, MD 20706. Contract FG01-86IE10506.

The Energy Policy Committee of the Atlantic Council of the United States and the Member Committee of the United States for the World Energy Conference formed a joint working group to take a fresh look at Western (OECD) interests in energy supply and use in developing countries. The resulting report examines the problems, issues and options related to economic energy development and utilization, considering the needs and capabilities of the developing countries as well as related interests of the industrialized democracies, generally the OECD countries. Major issues addressed are: (1) What are the factors that will encourage foreign private energy investment in developing countries, that is, the opportunity to invest with assurances of an ability to earn and to repatriate a fair return on investment? (2) What factors must be stressed if the institutional structure in developing countries is to be made more effective in addressing their energy problems? (3) Should the energy financing and development role of the World Bank and the regional development banks be expanded? If so, how? (4) Can the United States and other OECD governments do more to encourage energy development in developing countries? (5) What can be done to encourage commercial banks and other private institutions to invest in energy development in developing countries? Conclusions and recommendations are given. Individual reports are processed separately for the data base.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 29889, 29949, 30029, 30031, 30035, 30038, 30039, 30049, 30050, 30051, 30052, 30054, 30055, 30058, 30090, 30114, 30158, 30343, 30440, 30473, 30498, 30520, 31030, 31073, 31074, 31078, 31079, 31080, 31081, 31082, 31083, 31084, 31085, 31086, 31098, 31099, 31100, 31101, 31102, 31103, 31104, 31105, 31106, 31107, 31117, 31118, 31130, 31142, 31144, 31147, 31148, 31149, 31150, 31151, 31152, 31153, 31154, 31155, 31156, 31157, 31158, 31159, 31160, 31161, 31162, 31163, 31164, 31165, 31166, 31167, 31168, 31169, 31170, 31171, 31172, 31173, 31174, 31175, 31176, 31177, 31278, 31968

30406 **(EGG-HWP—8018) Project management plan for asbestos control at Randolph Air Force Base.** Broers, G.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 43p.

The United States Air Force Air Training Command (ATC) Headquarters requested assistance from the Idaho National Engineering Laboratory (INEL) in February, 1987 to develop processes and procedures and provide program management to minimize and

control asbestos hazard at its thirteen bases. This effort was requested by the ATC to comply with Executive Order 12088 under which the USAF is directed to meet all applicable federal, state, and local environmental regulations. In response to that request the efforts identified within this document provide the ATC with a thorough base-wide Asbestos Survey Report, an Asbestos Management Plan and an Operations and Maintenance Plan for Randolph AFB which, when implemented, will comply with current and anticipated federal laws and provide the base with accurate information needed for long range asbestos management. The other twelve bases will be surveyed and sampled in the four years to follow with appropriate asbestos management plans developed for each. 6 figs.

30407 **(HRP—0907160/6/XAB) Evaluating the environmental health work force.** (Levine Associates, Inc., Rockville, MD (USA)). Jan 1988. 125p. NTIS, PC A06/MF A01.

The project evaluates the adequacy of the environmental health professionals work force. There are approximately 715,000 persons employed in professional and technical positions in 1987. Only 80,000, or about 11%, have formal education in environmental health. Another 155,000 (22%) are professionals with relevant skills such as engineers and chemists who are currently conducting environmental health activities, but who have no training in public health. The remaining individuals are technicians and operators. Experts agreed that at least 40,000 of the present work force is inadequately trained and that an additional 120,000 professionals are required to adequately solve environmental problems and objectives. Numerous recommendations were proposed to solve these work force and education/training problems.

30408 **(INIS-GB—125) NAIR: handbook on the national arrangements for incidents involving radioactivity. Revised edition.** (National Radiological Protection Board, Chilton (UK)). 1987. 87p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752752/JAW.

A revised handbook on the national arrangements for incidents involving radioactivity (NAIR) has been published. Following brief introductory sections on the administrative aspects and operational aspects, the main part of the handbook is devoted to operational and call-out lists including an index of police forces served by NAIR, an index of establishments providing assistance under NAIR, sources of stage 1 and stage 2 assistance for each police constabulary, hospitals prepared to accept contaminated casualties and to assist with decontamination of personnel, and hospitals prepared to advise on the treatment and admission of casualties exposed to large doses of radiation. Technical appendices are also given on radiological protection in NAIR incidents, instruments and equipment, radionuclide data and a guide to suitable detectors, package and source identification and disposal of radioactive materials involved in NAIR accidents. (U.K.).

30409 **(INIS-XN—4) Act No. 85-661 of 3 July 1985 amending and supplementing Act No. 76-663 of 19 July 1976 on installations classified for purposes of environmental protection.** (Nuclear Energy Agency, 75 - Paris (France)). 4 Jul 1985. 2p. (In French).

This Act both amends and supplements Act No. 76-663 of 19 July 1976 on installations classified for environmental protection purposes. In particular, the new provisions increase the penalties prescribed in cases where classified installations are operated in illegal conditions.

30410 **(ORNL—6445) ORNL Long-Range Environmental and Waste Management Plan: Program overview and summary.** Bates, L.D.; Berry, J.B.; Butterworth, G.E.; du Mont, S.P. III; Easterday, C.A.; Geisler, A.H.; Hill, L.G.; Kendrick, C.M.; McNeese, L.E.; Myrick, T.E.; Pudelek, R.E.; Rohwer, P.S.; Scanlan, T.F.; Stratton, L.E.; Trabalka, J.R.; Youngblood, E.L. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 67p.

The primary purpose is to provide a thorough and systematic planning document to reflect the continuing process of site assessment, strategy development, and planning for the current and long-term control of environmental issues, waste management practices, and remedial action requirments. The document also provides an estimate of the resources required to implenent the current plan. As with any document of this nature, the near-term (one to three years) part of the plan is a realistic assessment of the current program and ongoing capital projects and relects the efforts preceived to be necesary to comply with all current state and federal regulations and DOE orders. It also should be in general agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication. 15 figs., 10 tabs.

30411 **(ORNL—6445/R1) ORNL long-range environmental and waste management plan: Program overview and summary.** Bates, L.D.; Berry, J.B.; Butterworth, G.E.; du Mont, S.P.; Easterday, C.A.; Geisler, A.H.; Hill, L.G.; Kendrick, C.M.; McNeese, L.E.; Myrick, T.E.; Pudelek, R.E.; Rohwer, P.S.; Scanlan, T.F.; Stratton, L.E.; Trabalka, J.R.; Youngblood, E.L. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 67p.

The primary purpose of this report is to provide a thorough and systematic planning document to reflect the continuing process of site assessment, strategy development, and planning for the current and long-term control of environmental issues, waste management practices, and remedial action requirements. The docuemnt also provides an estimate of the resources required to implement the current plan. This document is not intended to be a budget document: it is, however, intended to provide guidance to both Martin Marietta Energy Systems, Inc., and the US Department of Energy (DOE) Management as to the near order of magnitude of the resources (primarily funding requirements) and the time frame required to execute the strategy in the present revision of the plan. The near-term (one to three years) part of the plan is a realistic assessment of the current program and ongoing capital projects and reflects the efforts preceived to be necessary to comply with all current state and federal regulations and DOE orders. It also should be in general agreement with current budget (funding) requests and obligations for these immediate years. Beyond the immediate time frame, the document reflects the strategy and the project and funding estimates as a snapshot at the time of publication. Annual revision will reflect the continuing evoltuion and development of environmental and waste management processes, characterizations, remedial actions, regulations, an strategies for the establishment and conduct of a comprehensive environmental and waste management program. 15 figs., 10 tabs.

30412 **(ORNL—6450/R2) Environmental regulatory update table, February 1988.** Langston, M.E.; Nikbakht, A.; Salk, M.S. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 112p.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for taht initiative with an abstract and a projection of further action.

30413 **(ORNL—6455) Oak Ridge National Laboratory health and safety long-range plan: Fiscal years 1988-94.** (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 104p.

The Oak Ridge National Laboratory Health and Safety Long-Range Plan provides a summary or the overall health and safety management strategy developed to date. This health and safety long-range plan is the first of a series of planning documents to be issued annually. As the first document in the series, it must rely upon the current level of knowledge regarding technical and regulatory requirements. Subsequent reports will benefit from refinements in our current level of understanding of health and safety issues and more detailed information on proposed regulatory changes. This Long-Range Plan is organized into the following programmatic areas: health pahysics, industrial hygiene, occupational medicine, industrial safety, nuclear criticality safety, nuclear facility safety, transportation safety, fire protection, and emergency preparedness. A report on the mission and objectives of each pro-

gram, an enumeration of operation requirements, a summary of program needs and a detailed scheduling and funding information are provided for each area of the Laboratory's health and safety programs. 34 tabs.

30414 **(PB—88-171293/XAB) CONCAWE Senior Management Seminar, 8-9 October, 1987 Environmental Protection in the 1990s. Main speaker presentations.** (Concawe, The Hague (Netherlands)). 1987. 63p. (CONCAWE—9/87). NTIS, PC E04/MF A01.

The report contains the texts of the presentations made by the main speakers at the CONCAWE Senior Management Seminar entitled Environmental Protection in the 1990s, held on 8th-9th October 1987. The seminar represents a part of the CONCAWE contribution to the European Year of the Environment which also coincides with CONCAWE's 25th anniversary year. The topics of the main speakers are: Mr. Stanley Clinton Davis, Environmental Protection in the 1990s; Professor J. Diez Nicolas, Changing Social Values; Professor E. H. von Weizsacker, Public Environmental Consciousness - How Does It Affect European Industry; Mr. Hugh Fish, CBE, Scientific Understanding: the Key to Environmental Conservation; Minister Professor Dr. K. Topfer, Environmental Policy in the Federal Republic of Germany - A Matter of Irrational Shortsight or Indispensable Precaution; Mr. H. de Ruiter, The Environmental Challenge - an Oil Industry View. Also included is an Appendix listing the seminar participants.

30415 **(PB—88-174362/XAB) Summary of annual reports on hazardous waste for 1983 through 1986: generation, treatment, storage and disposal.** Wright, H.A.; Theios, E.P. (Illinois Environmental Protection Agency, Springfield (USA). Div. of Land Pollution Control). Dec 1987. 64p. (IEPA/LPC—87/019). NTIS, PC A04/MF A01.

See also report dated Dec 86, PB—87-154134.

The report is a product of Illinois' Annual Report requirements for reporting years 1983 through 1986, for hazardous waste as defined under the Resource Conservation Recovery Act (RCRA) and the comparable Illinois regulations. Several comprehensive tables are included: listing by RCRA Hazardous Waste Number of the volume of waste shipped off-site by Illinois generators and the amount of waste stored, treated, or disposed by Illinois facilities.

30416 **(PB—88-192687/XAB) National dioxin study - report to Congress.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Aug 1987. 172p. (EPA—530/SW-87/025). NTIS, PC A08/MF A01.

This report presents the results of EPA's investigation of potential 2,3,7,8-TCDD (dioxin) contamination. The report also includes information on chemical reactions and on sources and pathways of human exposure.

30417 **(PB—88-862412/XAB) Hazardous materials transportation. January 1977-April 1988 (Citations from the NTIS data base). Report for January 1977-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 187p. NTIS PC N01/MF N01.

Supersedes PB—87-857694.

This bibliography contains citations concerning the transport of hazardous materials primarily by road, rail, and cargo vessel. Risk assessment, accident analyses, response programs, and explosives container design aspects are among the topics discussed. Federal legislative aspects and state programs, and test procedures for a variety of containers are also considered. Selected fossil fuels, explosives, and hazardous chemicals are among the materials presented. Citations pertaining specifically to radioactive materials are discussed in a separate bibliography. (This updated bibliography contains 377 citations, 27 of which are new entries to the previous edition.)

2904 Natural Resources

REFER ALSO TO CITATION(S) 29916, 30174, 30175, 30176, 30178, 30179, 30224, 30397, 31030, 31142, 31968

30418 (CONF-8605117—, pp 1-6) **Development of alternative energy sources and the lessons learned since the oil embargo.** Fletcher, A.G. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper describes the current atmosphere in the US on alternative fuels to replace the current dependence on foreign oil. It describes the economic instability the US dependence places on the world energy market. It goes on to describe eight basic principles for developing the technology to provide the US with an adequate supply of energy and by-pass the potential threat on the economic and security of the nation. These include enhanced recovery of existing fuels; development of inexhaustible fuels; processing of current waste fuel forms; development of better storage and transmission facilities; changing their energy use to be less wasteful; research and development in complimentary fields of technology; and methods to preserve the health and safety of the people and the environment involved in these technologies.

30419 (CONF-8605117—, pp 7-10) **Plea for developing alternative energy sources as a deterrent.** Saluja, S.S. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the need for developing an alternate energy supply to replace the dwindling oil and gas reserves. It discusses the economic hardships faced by developing countries during the 1973 oil embargo and the lessons such countries as India learned from these crises. It then goes on to discuss alternative energy sources that were started in the US and abandoned when the oil prices stabilized. These included various coal gasification projects and synthetic fuel programs. The author goes on to warn that the current market conditions are not reflective of the future and that the US should be rapidly developing alternative energy sources so it can survive the next shortage.

30420 (CONF-8605117—, pp 11-16) **Energy in the eighties and nineties.** Andrews, M. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses the current dependence the US has on foreign oil and the substitute energy sources the US is abandoning. It discusses the availability of US coal resources and the development of clean coal technology. It then describes the rise and fall of the synthetic fuel industry and why they should be striving to achieve this goal instead of abandoning it. It then goes on to describe the closing of coal gasification projects in North Dakota and the availability of coal fuel technology. It culminates with a discussion of the use of ethanol and the problems and economics of nuclear fuels.

30421 (CONF-8605117—, pp 21-28) **Engineering and economic constraints on the development of synfuels and alternative energy sources.** Parker, H.W. (Texas Technological Univ., Lubbock (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Medium-term, world-wide abundance of petroleum will continue to delay commercial production of synfuels and alternative energy sources. Large fluctuations in oil exploration activities, caused by large changes in oil price account for short term shortages and surpluses of petroleum producing capacity. Overlooking

the importance of these cycles has made rational planning regarding alternative energy sources difficult. Petroleum reserves are finite, but large. Conservation and displacement of petroleum and natural gas with coal and biomass will serve to extend the availability of petroleum. There will not be requirements for large scale synfuel plants until beyond 2020 or perhaps later, assuming a reasonable stable global political environment. At that time other factors will complicate planning for large scale use of synfuels and alternative energy sources. These factors include difficulty in making unbiased cost estimates, need for the economies of large scale operation, higher valued uses for biomass than energy, and parallel inflation of energy costs and commercial construction costs.

30422 (CONF-8605117—, pp 35-44) **Changing economics of producing fuel from agricultural products.** Wulff, S.M.; Little, R.D.; Helgeson, D.L.; Johnson, R.G. (North Dakota State Univ., Fargo (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

High energy prices resulting from the oil embargo and other shocks to the world oil market provided economic impetus for research and development of alternative energy sources. Much of the technology developed, although promising, did not become economically competitive, even at the high energy prices that prevailed through the late 1970's and early 1980's. This was true for commercial production of fuels from agricultural products. The objective of this paper is to examine the economic relationships between the cost of producing fuels from agricultural commodities and the price of petroleum products during the period 1970 to 1985. Discussion will focus on commercial production of vegetable oil fuel from sunflower oil seeds as an extender or substitute for diesel fuel and ethanol from corn and barley as a gasoline extender.

30423 (CONF-8605117—, pp 53-55) **Full production cutback concept.** Klevberg, M. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper discusses a proposal for a government incentive on crop land to generate non-food crops. These crops would be converted to vegetable oil and ethanol fuels which could then be used to mix with diesel or other fuels. The advantages and disadvantages of the proposed program are discussed. This plan is meant to replace the acreage retirement program and generate both revenues and fuel in the process.

30424 (CONF-8605117—, pp 65-67) **Sugar cane: a versatile biomass energy source.** Samuels, G. (Biomass Consultant, Winter Park, FL (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Sugar cane has long been associated as the commercial swectener, sugar. Yet sugar cane, as a botanical entity, is best as an effective collector of solar energy which it stores with the structure of new tissues (fiber) rather than to accumulate it as soluble sugars. Fortunately, it has the ability to produce both fiber and fermentable sugars in considerable abundance. Sugar cane has declined in importance as an export crop due to lower sugar prices, higher labor costs and surplus production. The majority of the sugar exporting countries are oil importers for fuel for transportation and electrical production. This imbalance has caused economic havoc in these countries. Proper agronomic management has given sugar cane production as an energy crop double to triple that of conventional sugar cane on a hectare basis. This new biomass crop, energy cane, provides a multiproduction of boiler fuel for electricity, fermentable sugars for ethanol, sugar, and cellulostic feedstock for related industries rather than the narrow based economy of sugar production from sugar cane. The objective of this paper is to present the concept of the use of sugar cane as a biomass energy source.

30425 (CONF-8605117—, pp 68-74) **Strategic planning for the commercialization of synthetic fuels from coal.** Gholam-Nezhad, H. (Moorhead State Univ., MN (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

The main objective of this paper is to demonstrate the application of the Analytic Hierarchy Process (AHP) to promote production of synthetic liquid fuels from coal in the US. The two strategies chosen are free-market strategy and government-intervention strategy. Constraints binding each strategy are defined, and policies which would resolve these problems are formulated and assigned priorities. The uniqueness of this approach is the explicit consideration of intangible factors such as social, political, environmental, and technological factors in determining the priorities of the recommended policies.

30426 (CONF-8605117—, pp 75-85) **Production of a clean carbon fuel derived from coal and other carbonaceous raw materials for use in stationary and mobile heat engines.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper describes the development of a new process called HYDROCARB and the production of a new fuel product called CARBOLINE (an acronym for carbon-gasoline), which has potential world-wide economic usefulness. It is a clean carbon fuel which can be used in stationary, steam, electrical power generating plants and for mobile transportation engines. The HYDROCARB process converts any abundantly available carbonaceous raw material such as coal, peat, tar, biomass (wood), agricultural materials and commercial and industrial wastes, into a clean carbon fuel. This fuel is produced in two forms: one is a solid particulate carbon black, which can readily be burned in a boiler, turbine, or internal combustion engine, and the other is a clean liquid carbon fuel made by mixing the solid particulate carbon black with either water, alcohol, gasoline, oils or other conventional liquid fuel to form a mix or slurry fuel CARBOLINE. Because of the vast resources of coal throughout the world, the new process will have greatest applicability in the conversion of coal to clean solid carbon fuel and to a liquid CARBOLINE mix fuel competitive with world petroleum derived fuel costs.

30427 (CONF-8605117—, pp 145-152) **Development of energy in India during 1950-1985 and its future perspectives.** Rao, J.S. (Embassy of India, Washington, DC (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Energy is an essential input for economic development and improving the quality of life. Developing countries like India have missed the industrial revolution of the last two centuries and the main needs of energy are met by non-commercial resources like cow dung, fuel wood and agricultural wasters. Substantial improvements have taken place since the 1950's, but per capita consumption of commercial energy (coal, petroleum and electricity) will remain 1/8th of the world average. The commercial energy in India accounts for a little over half of the energy today. India adopted the five year plan strategy to improve the energy inputs and thus the quality of life after it gained independence. Six such plans have been completed and the developments that have taken place so far in the conventional energy sector viz. coal, petroleum and hydroelectricity; nuclear energy and in the field of nonconventional energy sources such as Biogas, Biomass, Solar thermal, solar photovoltaics, wind, and other renewable energies will be discussed. The perspectives on energy in the year 2000 will be presented.

30428 (CONF-8605117—, pp 156-158A) **EMFI at CSM: Rx for PR.** Baughman, G.L. (Colorado School of Mines, Golden (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

Two of the principal drawbacks of descriptive job, program, or presentation titles are that they rarely fit on registration forms and they usually comprise 80% of the sentences they are used in. Hence, the cryptic title for this preparation. The Energy and Minerals Field Institute (EMFI) at the Colorado School of Mines (CSM) is an educational program operated out of the Office of Special Programs and Continuing Education (SPACE). One of the Institute's primary functions is to familiarize selected audiences with the realities of Western resource development. This transfer of information corresponds closely with the public relations (PR) and governmental affairs functions of various industries and government organizations. As a result, the Institute can play an important role in getting one's point across to a targeted audience. The program is described.

30429 (CONF-8605117—, pp 167-169) **Solar energy: prospects and progress over the past decade.** Bath, T.D. (Solar Energy Research Institute, Golden, CO (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

This paper provides a summary of developments in solar energy technology. It discusses biomass production for synthetic fuels like ethanol; building energy systems using solar hot water systems; solar thermal energy systems designed to convert solar radiation to heat for industrial or chemical processes or to generate electricity; photovoltaics; ocean thermal energy conversion; and wind. The development of new materials and collectors is discussed along with their application.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 29842, 29843, 29863, 29912, 29917, 29981, 30173, 30174, 30175, 30176, 30178, 30189, 30224, 30227, 30343, 30395, 30405, 30418, 30419, 30420, 30422, 30424, 30425, 30426, 30427, 30428, 30429, 30440, 30441, 30442, 30649, 31117

30430 **(ANL/CNSV-TM—201-Ed.1) Catalog of junior inventor programs: First edition.** (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 22p.

This first edition of the Catalog of Junivor Inventor Programs is meant to be illustrative; that is, it is meant to show the diversity of junior inventor activities and programs by national organizations, local inventor clubs, and schools. It does not attempt to be comprehensive, but simply lists those activities we have identified to date. The information in this catalog is "self reported" by the organization or program summarized.

30431 (CONF-8605117—, pp 17-20) **Development of low-rank coal as an alternative energy source.** Wiltsee, G.A. (Univ. of North Dakota Energy Research Center, Grand Forks (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

During the last two decades low-rank coal has become a really significant energy source around the world for the first time. By far the largest use of low-rank coal is in the generation of electric power. The coal-to-SNG conversion process also transforms the energy into a convenient form, as exemplified at the Great Plains Gasification plant. In both cases the competition with other energy sources is tough and the need for improved technology to reduce costs is great. The University of North Dakota School of Engineering and Mines, which includes the Energy Research Center, the North Dakota Mining and Mineral Resources Research Institute, and the Coal Byproduct Utilization Institute, is deeply involved in many areas of research and development of low-rank coal technology. In some aspects of this work, today's problems are being solved through research related to coal mining, transport and storage, combustion, gasification, stack gas cleaning, waste treatment and disposal, and byproduct utilization. In other aspects of this work, technologies and data are being developed for application in the future, through research related to coal resource evaluation, coal science, underground coal gasification, coal/water slurry fuels, coal liquefaction, and production of hydrogen. The approach to this work is collaborative, with funding agencies, other research entities, and production and processing companies. The result will be the further development of low-rank coal as an alternative energy source.

30432 **(DOE/ER—0357) Procedures for peer review assessments.** (USDOE Office of Energy Research, Washington, DC. Office of Program Analysis). [1988]. 31p.

The Office of Program Analysis (OPA) conducts peer reviews of DOE research and development programs. The reviews are performed by examining individual projects which comprise the programs and assess the quality of the research, quality of the research tem, productivity, and mission relevance for each project reviewed.

30433 **(PB—88-183272/XAB) Papers commissioned by the panel on technology and employment.** Cyert, R.M.; Mowery, D.C. (National Academy of Sciences, Washington, DC (USA). Committee on Science, Engineering, and Public Policy). Nov 1987. 484p. NTIS, PC A21/MF A01.

Papers commissioned by the Panel on Technology and Employment asked scholars for an assessment of a diverse array of issues related to the employment-related impacts of technological change, ranging from the effects of new technologies on firm size on their implications for the distribution of income and employment in the future U.S. economy. Scholars were asked to survey areas of importance. In most cases, experts in the field were asked to survey an extensive literature and assess its implications for issues of concern to the Panel. In other cases, authors undertook original empirical or theoretical analyses of these issues. Many of the papers were presented at meetings of the Panel and discussed by the Panel.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 30029, 30035, 30036, 30037, 30038, 30049, 30050, 30051, 30052, 30054, 30055, 30072, 30090, 30092, 30095, 30100, 30114, 30278, 30297, 30298, 30396, 30420, 30528, 31178, 31179

30434 **(INIS-BR—1052) Power of ideology: computer and nuclear energy. Development in Argentina and Brazil.** Adler, E. (Instituto Universitario de Pesquisas do Rio de Janeiro (Brazil)). 1985. 43p. (CONF-8501119—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702316/JAW.

From International seminar on development and effectiviness of technological and scientific research; Rio de Janeiro, Brazil (15 Jan 1985).

IUPERJ - Serie Estudos.; no. 42.

A comparison between Argentina and Brazil is made, showing its investments and technological developments in the nuclear field. (E.G.).

2907 Transport And Storage

REFER ALSO TO CITATION(S) 30418

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 30508

2910 Conservation

REFER ALSO TO CITATION(S) 30458, 30459, 30483, 30487, 30510, 30511, 30512

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 29964, 29978, 30396, 30397, 30421, 30507, 31178, 31179

30435 **(DOE/EIA—0035(87/12)) Monthly energy review, December 1987:.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 28 Mar 1988. 142p.

During the second half of 1987{emdash}a year of relatively stable crude oil prices and continued economic growth{emdash}the domestic energy industry began to show signs of recovery from the market disruptions of 1986. The composite refiner acquisition costs of crude oil in 1987 averaged $17.91 per barrel, up from $14.55 in 1986. In addition, 1987 prices were much more stable, ranging from a low of $16.17 in January to a high of $19.36 in August. In contrast, 1986 prices had ranged from $25.63 in January to a low of $11.26 in July. Economic conditions also favored recovery. Domestic gross national product (GNP), measured in billions of 1982 dollars, was up by 2.7 percent compared with 1986 GNP, and the index of industrial production rose 4 percent from 1986 to 1987. This issue contains a review of 1987 energy activity.

30436 **(PB—88-862198/XAB) Energy supply and demand modeling. February 1985-March 1988 (Citations from the NTIS data base). Report for February 1985-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 112p. NTIS PC N01/MF N01.

Supersedes PB—86-857158.

This bibliography contains citations concerning the utilization of mathematical models in trend analysis and forecasting of energy supply and demand factors. Models are presented for the industrial, transportation, and residential sectors. Aspects of long-term energy strategies and markets are discussed at the global, national, state, and regional levels. Energy demand and pricing, and econometrics of energy, are explored for electric utilities and natural resources, such as coal, oil, and natural gas. Energy resources are modeled both for fuel usage and for reserves. (This updated bibliography contains 201 citations, 129 of which are new entries to the previous edition.)

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 30036, 30037, 30039, 30058, 30072, 30092, 30095, 30226, 30405, 30406, 30409, 30412, 30444, 30510, 30511

30437 **(DOE/S—0062) National Defense Authorization Act for fiscal years 1988 and 1989 (Public Law 100-180): A report to the Congress: Contingency plans to deal wih disruptions in Persian Gulf crude oil supply.** (USDOE Office of the Secretary, Washington, DC; Department of Defense, Washington, DC (USA). Office of the Secretary). Mar 1988. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007466/JAW.

The free world obtains a significant amount of oil from the Persian Gulf. The United States and other OECD countries cooperate under the aegis of the IEA to administer response programs and devise strategies to mitigate the economic and social impacts of future petroleum disruptions arising from any source. Chief among these strategies has been the development of government-owned and -controlled petroleum stocks. In addition to the United States' 545 million barrel SPR, other IEA member governments own or control strategic stocks amonting to over 390 million barrels of oil. The IEA members have developed and tested procedures for coordinating their response strategies, including drawdown of these stocks. Efforts by the United States and other countries to decontrol oil prices and dismantle cumbersome national allocation schemes have made economies more flexible and responsive to any future disruptions. While the existing authorities allow for adequate responses in an emergency, the US Government supports the proposed five-year extension of the International Energy Program authorities. The Administration has also propsoed the development of a ten million barrel Defense Petroleum Inventory, financed by the scale of the Naval Petroleum Reserves. Our overall energy security can be strengthened by diversifying our energy sources through decontrolling the natural gas market, reforming nuclear power licensing, removing barries to free energy trade, encouraging new energy technologies and conservation, fostering full and efficient developemnt of domestic oil reserves, and the clean use of our domestic coal resources.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 29863, 29912, 29914, 29916, 29917, 29945, 29946, 29947, 29949, 29957, 29964, 29973, 29975, 29976, 29977, 29978, 29981, 29989, 30398, 30399, 30400, 30419, 30420, 30425, 30431, 30435, 30437

30438 **(DOE/EIA—M026) International Coal Trade Model Version 2 (ICTM-2): User's guide.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Mar 1987. 61p.

The purpose of this manual is to provide a functional guide for users of the International Coal Trade Model, Version 2 (ICTM-2). The manual is intended to provide users with the information necessary to obtain access to the model and its input data, to update the input data if required for their application, and to obtain the desired model outputs. The manual contains the following information: an overview of the TCTM-2 modeling system, a decription of the ICTM-2 input data, procedures for modifying the input data files, and procedures for running the model.

30439 **(DOE/IE/10369—T1) Contracting and price adjustment: An application to oil and copper markets.** Hubbard, R.G.; Weiner, R.J. (Harvard Univ., Cambridge, MA (USA). Energy and Environmental Policy Center). Feb 1986. Contract FG01-84IE10369. 40p. (E—86-02).

This paper characterizes price adjustment in markets where trade takes place through both contract and spot transactions. We develop a model of the effects of a two-price system on price adjustment to transitory shocks, demonstrating that the persistence effects of these shocks on prices depends on, {und inter alia}, the fraction of trades carried out through term contracts. In our applications, we focus on the copper and petroleum markets, though many other commodity and industrial product markets have experienced multiple-price regimes. Empirical tests of the model provide strong support for the notion that the increase in the importance of the spot market in the two markets is associated with a significant change in the price adjustment process. Some implications for public policies for price stabilization in commodity markets are discussed. 73 refs., 2 tabs.

30440 **Clean coal round 2 competition begins: release of solicitation starts half billion dollar demonstration effort.** *Fossil Energy Review;* 4-5(Jan-Feb 1988).

The Department of Energy has opened the competition for more than half a billion dollars in federal funds to demonstrate a new generation of environmentally clean, innovative coal technologies. The program is the centerpiece of President Reagan's March 1987 pledge to boost the US's response to international concerns over acid rain. The nationwide competitions will be tailored to attract the most promising new technologies that are: capable of being commercialized in the 1990s; more economical than current technologies; and capable of significantly reducing emissions from existing coal burning facilities, particularly those that contribute to

pollution that is transported across state lines or outside US boundaries.

30441 DOE begins 9th year of University Coal Research Program. *Fossil Energy Review;* 9(Jan-Feb 1988).

The US Department of Energy has again called on the nation's academic community to submit novel coal research ideas under a federal program that has provided nearly $40 million in federal grants to nearly 100 colleges and universities in its eight year history. The department's Pittsburgh Energy Technology Center had received 299 proposals when the deadline for submissions passed on January 29. Proposals were in the following areas: coal science; coal surface science; reaction chemistry; advanced process concepts; engineering fundamentals and thermodynamics; environmental science; and high temperature phenomena. DOE will announce the selection of the university grant awards in late April.

30442 Fossil Energy organization restructured. *Fossil Energy Review;* 10-11(Jan-Feb 1988).

The Department of Energy has restructured its fossil energy organization to accommodate increases in activity and visibility of the President's $2.5 billion clean coal technology initiative. The realignment also includes changes in the coal research and development program and in supporting staff functions. In the coal program, changes in the organization include the establishment of two associate deputy assistant secretaries, both reporting to the deputy Assistant Secretary for Coal Technology. One associate deputy assistant secretary will oversee the Clean Coal Technology Program. A second associate deputy assistant secretary will manage the coal research and development program. An organizational chart illustrates the new fossil energy headquarters organization.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 30420

2960 Electric Power

REFER ALSO TO CITATION(S) 29946, 30226, 30238, 30404, 30418, 30454, 30485, 30507, 31093

30443 (AD-A—189128/2/XAB) Investigation of waveform distortion in mobile electric power systems. Final report, October 1986-November 1987. Howard, P.D. (Army Belvoir Research Development and Engineering Center, Fort Belvoir, VA (USA)). Dec 1987. 23p. (BRDEC—2459). NTIS, PC A03/MF A01.

Ten DOD power generator systems were tested by Belvoir RD&E Center's Systems Assessment Team to determine power-distortion presence and to demonstrate the electrical conditions that exist with these systems under normal field conditions. Testing responded to the Inspector General's Report on the Survey of Acquisition of Mobile Electrical Generators and Related Equipment dated Feb 86. Tests determined representative levels of wave-form distortion experienced under typical field operation conditions. Based on test results, the present generator set specifications for waveform requirements are adequate to ensure satisfactory system operations.

30444 (DOE/EA—0308) Redding Direct Interconnection Project, Shasta County, California:. (Department of Energy, Sacramento, CA (USA). Western Area Power Administration). 1986. 190p.

As required under the California Environemtnal Quality Act (CEQA), the City of Redding (City) has prepared an Environmental Impact report (EIR) for the proposed Direct interconnection Project. Western Area Power Administration (Western) is also required to prepare an environmental assessment (EA) under the National Environmental Policy Act (NEPA) due to its involvement in the Project. Since the City has alrady prepared their EIR, this EA will briefly summarize the impact assessment field work and findings from the City's EIR. The EIR is attached as an appendix to this EA. 21 refs., 20 figs., 10 tabs.

30445 (DOE/EI/19801—H1) Documentation of the National Utility Financial Statement (NUFS) model: Final report. (ICF, Inc., Fairfax, VA (USA)). Mar 1988. Contract AC01-87EI19801. 172p.

This report describes the methodology and use of the National Utility Financial Statement (NUFS) model. NUFS is a financial model used by the Energy Information Administration (EIA) to forecast financial variables for the electric utility industry. The NUFS methodology is now embedded in the Electricity Market Module of the Intermediate Future Forecasting System (IFFS) in which it is used to forecast electricity prices and financial parameters for the electric utility industry. In addition, the NUFS methodology can be used in a similar manner in conjunction with the National Coal Model (NCM). This report describes in detail the model's methodology, inputs, outputs, running procedures, and the computer code. This volume is meant to replace all earlier descriptions of the NUFS model and describe the current NUFS methodology as of March 1, 1988.

30446 (DOE/EIA—0226(87/12)) Electric power monthly, December 1987. (Carpenter Environmental Associates, Inc., Northvale, NJ (USA)). Dec 1987. 47p.

During December 1987m net generation from nuclear power set an all-time record when 42,006gigawatthours of electricity were produced, breaking the previous record set in August 1987. Nuclear-powered units also reached a milestone this month by producing over 19 percent of the total US net generation. Coal-fired plants produced 126,199 gigawatthours during december 1987, 7 percent higher than the level reported a year ago. During December 1987, coal-fired and nuclear-powered units produced over 76 percent of the total US net generation. During November 1987, the average price of coal delivered to steam-electric plants with a combined installed nameplate capacity of 50 megawatts or larger was #31.08 per ton, $1.08 less than during November 1986. The average price of petroleum was $18.90 per barrel, $4.22 more than the price during November 1986. The average price of gas during November 1987 was $2.27 per thousand cubic feet, $0.02 more than the price during November 1986. 1 fig., 27 tabs.

30447 (EPRI-EM—5309-CCM) Forecast master: Short-term forecasting package: User's manual, Version 2.1. Goodrich, R.L.; Stellwagen, E.A. (Business Forecast Systems, Cambridge, MA (USA)). 1988. 176p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920225/JAW.

Your FORECAST MASTER forecasting package contains highly developed statistical forecasting programs for use in business, science and finance. The package makes sophisticated and accurte foreasting methodologies easy to use and, for the first time, readily accessible to the user who is not also a specialist in statistical forecasting. FORECAST MASTER provides the user with seven procedures to fit a statistial model to a historical time series of one or more dependent (endogenous) and one or more independent (exogenous) variables. The resulting model is then used to compute forecasts of the dependent variable(s) into the future. You can obtain forecasts of key macroeconomic variables like GNP from external sources, and use them in preparing your own forecasts. All of the forecasting procedures follow the same easy to understand format. A full range of standardized diagnostic statistics and graphical output is presented as each trial model is fitted to the historical data. The program itself will guide you in improving your model. Very few keystrokes are required. The programs run virtually automatically, except if you want to deviate from the default parameters. The default settings are presented to you in full screen deisplay, to be changed as desired. An online help facility is always ready to assist you. You should rarely have to consult this manual after your first time through.

30448 (EPRI-EM—5630-Vol.1) Customer response to interruptible and curtailable rates: Volume 1, Methodology and results: Final report. Caves, D.W.; Herriges, J.A.; Windle, R.J. (Christensen (Laurits R.) Associates, Inc., Madison, WI (USA)). Mar 1988. 159p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920263/JAW.

Interruptible or curtailable (I/C) service, one of the fastest growing utility programs, provides the utility with both an innovative rate alternative as well as a demand side management tool. This project examines existing (I/C) programs with the objective of providing information that will enable utilities to plan for future I/C programs. First, the report summarizes the rate and customer characteristics of I/C programs at ten utilities. Second, the report presents a regression technique that can be used to assess load relief provided by customers on I/C rates. The report demonstrates the technique by assessing load relief for each of the ten utilities. Tests of the regression technique showed it to be significantly more accurate than other procedures that are sometimes used. Utilities can implement the regression technique using standard statistical software in conjunction with the RELIEF software that was developed as part of this project. Finally the project examined those customer and program factors that influence load relief. Important customer factors were type of industry and load factor. Important program characteristics were number of interruptions, length of size of credit. 12 refs., 44 figs., 35 tabs.

30449 **(EPRI-EM—5705) Innovative rate design survey, 1986: Final report.** Simon, L.A.; Weiss, M. (Ebasco Business Consulting Co., New York (USA)). Mar 1988. 462p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920259/JAW.

This report presents the results of a survey on electric utility innovative rate design activity in the United States today. The survey, conducted during 1986, invited responses from all major investor-owned utilities and a representative sample of non-investor owned utilities. For the 11 innovative rate designs surveyed, information is catalogued by class of service and type of rate, either already in effect or in active planning. With regard to implemented rates, the survey includes information on items such as number of customers on rate, cost basis of the rate design, customer acceptance, and rate structure features. The survey results show that Time-of-Use rates have the highest recorded activity level among both utility groups. The second most frequently implemented rate type is Interruptible/Curtailable. The appendices to this report contain data base output listings of the results from each responding utility and for each rate type surveyed. Summary listings are also provided both by utility and by rate design in order to serve as a directory for utility planners and ratemakers with specific rate development interests.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 29946, 29948, 30403, 30435

30450 **(EPRI-EM—5706) DSM [demand-side management] program monitoring: Final report.** Bernstein, H.M.;Barnes, H.H.;McCarthy, P.M.;Manuel, T.K.;Kirksey. (Applied Management Sciences, Inc., Silver Spring, MD (USA); Battelle Columbus Div., OH (USA)). Mar 1988. 206p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920248/JAW.

Electric utilities operate demand-side management (DSM) programs to modify their system load shape in ways that will enhance profitable operations and strengthen customer relations. Programs monitoring provides the information needed to determine whether the programs have achieved their objectives. This report presents an overview of research designs and techniques for DSM program monitoring. DSM program managers can use it to acquire an understanding of program monitoring and the methodological alternatives available for its performance. The report presents (1) an overview of utility monitoring practices, (2) a generalized framework for designing and conducting program monitoring, and (3) an overview of illustractive monitoring designs and techniques. Several case studies illustrate the application of these dsigns and techniques. 66 refs., 30 figs., 21 tabs.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 30423, 31078

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

30451 **(AD-A—189619/0/XAB) Diagnostics for intelligent control of MPD (magneto-plasma dynamic) engines. Annual report No. 2, September 1986-September 1987.** Shoureshi, R.; Murthy, S.N. (Purdue Univ., Lafayette, IN (USA). School of Mechanical Engineering). 29 Oct 1987. 161p. NTIS, PC A08/MF A01.

In developing an approach to determining diagnostics for intelligent control of MPD thrusters, two concurrent studies were carried out: a stability analysis, and a plasma modeling. An advanced technique for derivation of stability requirements of distributed parameter systems based on mathematical theorems of semigroups and groups, equivalent norms, Lyapunov functionals, etc. was developed. Application of this technique to the MPD thrusters has resulted in control inputs for stabilizability of the system when perturbed from a general-equilibrium state of the plasma. A model was developed for the state of plasma near the cathode of an MPD-thruster engine. The region was divided into collisionless and collisional parts and full account is taken of the nonequilibrium state of the plasma over the entire region. A scheme for solving the set of describing equations based on an interative procedure was developed. For low- and high-current inputs, it is expected that the extent of the different regions and the marching conditions in the different regions will change indicating the trends towards the arising of onset instability.

30452 **(DOE/PC/79669—T1) Conceptual design of a coal-fired MHD retrofit of the J.E. Corette Plant: Design definition.** (MHD Development Corp., Butte, MT (USA)). Feb 1988. Contract AC22-87PC79669. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006208/JAW.

The design, construction, and operation of a fully integrated coal burning MHD/steam-power system has been identified as a necessary step for commercialization of MHD power gerneation. The addition of an MHD power system to an existing utility's conventional steam power plant is presently considered an efficient and attractive method for realization of this, and the conceptual design of a coal-fired MHD power plant has been initiated as an important item of the National MHD development program. Current activities of the MHD development program comprise proof-of-concepts testing of MHD topping cycle components and bottoming cycle components at the Components Development and Integration Facility (CDIF) and the Coal Fired Flow Facility (CFFF), respectively, at subscale levels. The MHD plant will provide for operation and testing of a fully integrated MHD/steam power system in a utility environment at a larger size consistent with its objectives. Its main objectives are to verify the technical and economic feasibility of commercial MHD power genration including environmental aspects and to provide electric utilities and equipment manufacturers with the necessary information and confidence to proceed with commercialization of MHD. The coal-fired J.E. Corette steam plant unit of the Montana Power Company at Billings, Montana has been selected for this MHD conceptual design activity.

3003 Thermoelectric Generators

30453 **(CONF-8709187—1) Moisture insensitive charcoal canisters.** Lucas, H.F. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 3p. NTIS, PC A; Q 02/MF A01; GPO Dep. Order Number DE88005916/JAW.

From Technical exchange meeting on passive radon monitoring; Grand Junction, CO, USA (21 Sep 1987).

Continuous monitoring of ^{222}Rn concentrations in the air in houses is the most appropriate approach for the real-time measurements, but this requires complex and expensive instruments and is not practical for large studies. Activated carbon canisters have been

used extensively for determining the average concentration over a period of a few days. The "open face" charcoal detectors have an integration time constant of about 14 h so that they are sensitive to short-term transient changes in the radon concentration. In addition, water uptake at high relative humidities reduces the radon uptake by the charcoal. The addition of a diffusion barrier and a nylon screen results in a charcoal detector with an integration half-time ranging from 20 to 60 h and a reduced uptake of water at high humidities. Silicone rubber sheeting is relatively permeable to radon and impermeable to water vapor. It was the purpose of this study to evaluate the effect of a silicone barrier on the charcoal canister radon collective device. 3 refs.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 30388, 30393, 30801

30454 (DOE/MC/22012—2566) Phosphoric acid fuel cells in residential applications: Final report. Hackworth, J.H.;Goudarzi, L.;Griswold, D. (KOH Systems, Inc., Rockville, MD (USA); IEAL, Fairfax, VA (USA)). Jun 1987. Contract AC21-85MC22012. 71p. NTIS, PC A04. Order Number DE88001064/JAW.

The residential market for the phosphoric acid fuel cell (PAFC) was assessed for the states of the Northeast and North Central census regions. The investment that could be supported by the fuel savings of a 1 kw PAFC installed in 1992 would be in the range of $1300-$1800, based on a 5 year pay out. The most critical market factor affecting the economics of the fuel cell in residential application is the price differential between electricity and natural gas. The fuel cell looks more attractive in the populous states of the Northeast and North Central region as the differential between gas and electricity prices is 27% more than that for the national average. Extending application of the fuel cell to meet residential space heating needs look unattractive. In space heating the return comes from more efficient use of gas rather than reducing purchase of high priced electricity and the energy requirement varies dramatically over the season leading to poor fuel cell capacity utilization. This analysis provides several valuable results useful in formulating future fuel cell research plans. 19 tabs.

30455 (DOE/MC/23136—2558) The effects of halides on the performance of coal gas-fueled molten carbonate fuel cells: Final report, October 1986-October 1987. Magee, T.P.; Kunz, H.R.; Krasij, M.; Cote, H.A. (International Fuel Cells Corp., South Windsor, CT (USA)). Oct 1987. Contract AC21-86MC23136. 197p.

This report presents the results of a program to determine the probable tolerable limits of hydrogen chloride and hydrogen fluoride present in the fuel and oxidant streams of molten carbonate fuel cells that are operating on gasified coal. A literature survey and thermodynamic analyses were performed to determine the likely effects of halides on cell performance and materials. Based on the results of these studies, accelerated corrosion experiments and electrode half-cell performance tests were conducted using electrolyte which contained chloride and fluoride. These data and the results of previous in-cell tests were used to develop a computer for predicting the performance decay due to these halides. The tolerable limits were found to be low (less than 1 PPM) and depend on the power plant system configuration, the operating conditions of the fuel cell stack, the cell design and initial electrolyte inventory, and the ability of the cell to scrub low levels of halide from the reactant streams. The primary decay modes were conversion of the electrolyte from pure carbonate to a carbonate-halide mixture and accelerated electrolyte evaporation. 75 figs., 16 tabs.

30456 (DOE/MC/23267—2537) Sulfur-tolerant anode materials: Annual report, September 1986-September 1987. Remick, R.J.; Osif, T,; Lawson, M. (Institute of Gas Technology, Chicago, IL (USA)). Sep 1987. Contract AC21-86MC23267. 78p.

This report summarizes the results of the first year's technical effort performed on a program identifying and evaluating alternative anode materials for use in molten carbonate fuel cells (MCFC) operating with high levels of sulfur contaminants in the fuel. A literature survey was performed on materials for use in the MCFC and on materials exhibiting good electrical conductivity at high temperature. A list candidate materials having a reported electrical conductivity in excess of 0.1 $(ohm\text{-}cm)^{-1}$ was compiled. 19 candidate materials were selected, and nine have been tested for electrical conductivity and for stability in the molten eletrolyte. To date, only cobalt metal has proved to be stable under all test conditions. Several water-gas shift catalysts were also evaluated for their catalytic activity and sulfur resistance under conditions prevailing in the MCFC anode. 19 refs., 24 figs., 21 tabs.

30457 Molten carbonate fuel cell. Kaun, T.D.; Smith, J.L. (to Dept. of Energy, Washington, DC). US Patent 4,714,661. 22 Dec 1987. Filed date 8 Jul 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A molten-electrolyte fuel cell device is described including a vertical, stacked array of individual fuel cells having at least four major vertical surfaces with vertical edge sections joining the vertical surfaces. The cells include anode and cathode electrodes separated by electrolyte material with the respective electrodes of all of the cells being exposed along opposite and common vertical surfaces to provide access to fuel or oxidant gases and removal of waste gases therefrom. The fuel cell device comprises: an array housing enclosing the array and having vertical sides cooperating with the edge sections of the array in a sealing relationship to define at least four isolated gas manifolds; electrode holder arranged in spaced pairs; spacer means disposed between and in contact with adjacent pairs of electrode holders for defining a substantially closed space within which is disposed the electrolyte; dry sealing means disposed between and in sealed contact with the spacer means and adjacent pairs of electrode holder for confining the electrolyte between an adjacent pair of electrode holders; and means including first and second manifolds for providing fuel and oxidant gases respectively to the anode and cathode electrodes and third and fourth manifolds for removing waste gases respectively from the anode and cathode electrodes.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

30458 (CONF-8605328—) Citizens' conference on energy conservation and utility policy:. (Citizens Energy Advisory Commission, Washington, DC (USA)). 1986. 72p. Citizens Energy Advisory Commission, 613 G Street, N.W., Suite 500, Washington, DC 20001; GPO Dep. Order Number TI88900463/JAW.

From Citizens' conference on energy conservation and utility policy; Washington, DC, USA (2 May 1986).

On May 2, 1986 the DC Citizens Energy Advisory Committee (CEAC) and the DC Consumer Utility Board (CUB) convened a day-long "Citizens' Conference on Energy Conservation and Utility Policy" at the Carnegie Library, University of the District of Columbia. The conference brought together a diverse group of panelists and participants for a broad discussion of energy policy problems, both at the national and local level. This report summarizes the perspectives offered on these problems by the Conference panelists. Funding for the Conference was provided by a grant from the DC Energy Office Extension Service.

3201 Buildings

REFER ALSO TO CITATION(S) 29974, 30387, 30453, 30454, 31073

30459 (AD-A—189632/3/XAB) Identification of ways to improve military construction for energy-efficient facilities. Final report. Chu, D.; Burton, C.; Imel, M. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Dec 1987. 72p. (CERL-TR-E—88/02). NTIS, PC A04/MF A01.

To meet goals for lower energy consumption at Army facilities, the U.S. Army Corps of Engineers (USACE) has altered its standard design guidance to include energy-efficient designs for military construction. However, energy-conscious design is only one component required in an overall plan to reduce energy in new

facilities. Equally important are the quality of construction procedures and materials and the operation and maintenance methods used once the facility is placed in service. Thus, it is necessary to control techniques, materials, and equipment as part of the Military Construction, Army (MCA) process to ensure that energy-conscious designs can be implemented successfully. Based on surveys of the USACE construction community and installation new facility users, the U.S. Army Construction Engineering Research Laboratory (USA-CERL) has developed recommendations to improve the MCA procedure and ensure energy-efficient facilities. These recommendations include improving the quality control/quality assurance inspection process; requiring a comprehensive system-wide operating manual from the facility designer; and establishing a reliable acceptance-testing procedure for HVAC systems. USA-CERL has completed preliminary work on an acceptance-testing program.

30460 **(BNL—52104) Strategies for energy conservation through residential zoning and reduction of duct losses.** Andrews, J.W.; Murray, J.G. (Brookhaven National Lab., Upton, NY (USA)). Jul 1987. Contract AC02-76CH00016. 109p.

Strategies to conserve energy in residences through zoning and reduced duct losses were developed and evaluated. Ten zoning strategies and six duct-low reduction strategies were considered. A research agenda is presented that will further define the potential and applicability of these strategies. 35 refs., 10 figs., 10 tabs.

30461 **(CONF-860818—19) Technical and practical problems of developing and implementing an improved retrofit audit: [Final report].** McCold, L.N.;Schlegel, J.A.;Hewitt, D.C. (Oak Ridge National Lab., TN (USA); Wisconsin Energy Conservation Corp. (USA)). 1986. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007261/JAW.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

Oak Ridge National Laboratory developed a retrofit audit suitable for use in the Low-Income Weatherization Assistance Program. The audit selects the most cost-effective retrofits from among about a dozen building shell and heating system retrofits. The audit was field tested this past winter on 35 single-family houses in Wisconsin. This paper describes the important technical problems encountered in developing and implementing an accurate audit. Two types of technical problems were observed. The first type is that the best models available for determining the energy savings of some retrofits produce unreliable results. The second technical problem was related to the audit data;some of the data needed to make accurate energy savings estimates were difficult to obtain or were dependent on auditor judgement. The practical problems included policy or equity questions and difficulties encountered in implementing the audit. This paper discusses the various types of research needed. The discussion also serves to focus attention on the issues, which, it is hoped, will stimulate development of ideas for dealing with these technical and practical problems.

30462 **(CONF-860818—20) Predicting energy use: [Influence of the recording interval: [Final report].** Sharp, T.R. (Oak Ridge National Lab., TN (USA)). Jun 1986. Contract AC05-84OR21400. 13p.

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The recording interval used to record energy use data for evaluating the performance of residential buildings often differs considerably when comparing energy use evaluation studies. Utility dta are typically recorded on an approximate monthly basis, which is in contrast to an evaluation of solar heat gain effects which may require hourly or more frequent data. A variety of recording intervals between these two is also commonly used. This paper discusses a study that showed that the recording interval has considerable influence on the heating energy use rate (slope) and the base temperature resulting from a regression model used heating energy use. Fifteen-minute space heating energy use data recorded for four electrically-heated homes in the Minneapolis, Minnesota, area between Jan,. 1 and April 30, 1982 were used in the study. The data aggregated to create the data sets needed to examine the effects of changes in the recording interval on model parameters. An increase in the recording interval increased the slope of the regression model and decreased the predicted base temperature of the building. In predicting annual space heating energy use in a typical meteorological year (TMY), the compensatory changes that occurred in the slope and base temperature were not sufficient to prevent significant differences. The variation was 1-7% for the 4 houses studied. 2 refs., 4 figs., 4 tabs.

30463 **(CONF-880128—6) An overview of 3-D graphical analysis using DOE-2 hourly simulation data.** Haberl, J.S.; MacDonald, M.; Eden, A. (Colorado Univ., Boulder (USA). Dept. of Civil, Environmental, and Architectural Engineering; Oak Ridge National Lab., TN (USA); Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1988. Contract AC05-84OR21400. 16p.

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

This paper presents an overview of a 3-D graphical approach for improving the potential of building energy analyses using the DOE-2 computer program. The approach produces 3-D annual profiles from hourly data generated by DOE-2 simulations using a statistical plotting package for specific quantities of interest. The annual profiles of hourly data provide a useful graphical check of voluminous data in a condensed form, allowing several different types of data to be plotted over a year. These profiles provide the user with the opportunity to check simulation results, check for potential problems with user input, provide graphs to customers who may want a simpler presentation, visualize interactions in simulations, and understand where inappropriate modeling conditions may exist in simulations. Future analysis, using such profiles, may allow methods to be developed to check consistency between simulations, check for potential hidden errors in modeling buildings, and better understand how simulations compare with data from real buildings. 22 refs., 23 figs., 1 tab.

30464 **(CONF-880382—1) A brief review of control measures for indoor formaldehyde.** Matthews, T.G. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. (CONF-880382—).

From American Thoracic Society workshop on indoor environmental controls and lung disease; Santa Fe, NM, USA (24 Mar 1988).

Indoor environments contain a variety of consumer and construction products that emit formaldehyde (CH_2O) vapor. The strongest CH_2O emitters are typically particleboard underlayment and industrial particleboard, hardwood plywood paneling, urea-formaldehyde foam insulation, and medium density fiberboard, all of which contain urea-formaldehyde (UF) resins. The contribution of individual products to indoor CH_2O levels depends on several parameters, including the quantity and age of the product, building ventilation rate, presence of permeation barriers, temperature (T), relative humidity (RH), and CH_2O vapor concentration resulting from all of the CH_2O emitters (1,3-8). Combustion sources (e.g., kerosene heaters, gas stoves and cigarettes), carpet and carpet padding, resilient flooring (e.g., linoleum), gypsum board, non-apparel and apparel textiles, ceiling tiles, fibrous glass insulation and softwood plywood subflooring are generally weak emitters that do not contribute significantly to steady-state, indoor CH_2O levels. Control measures exist to reduce CH_2O emissions from consumer and construction products during their manufacturer and in post-installation applications. This note summarized the effectiveness of the following subset of post-installation control measures: product aging, installations of permeation barriers (i.e., flooring) and increased building ventilation. 14 refs.

30465 **(CONF-880627—1) The impact of surface reflectance on the thermal performance of roofs: An experimental study.** Griggs, E.I. (Tennessee Technological Univ., Cookeville (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 32p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007473/JAW.

From ASHRAE annual meeting; Ottawa, Canada (25 Jun 1988).

The thermal effects of black versus white membranes on an insulated low slope roof were studied over an 18 month period.

Half of the insulated roof test panel's 4 ft x 8 ft surface was covered with a black polyisobutylene (PIB) membrane. A white PIB membrane was installed over the other half. Both sections were identically insulated with fiberglass board to provide a nominal thermal resistance of 7.5 hr-ft^2-{degree}FBtu. A heat flux transducer was installed in the center of each section with themrocouples placed below the membrane, at the midplane and beneath the insulation. Local weather data together with specimen heat flux and tempeature data were recorded hourly. Seasonal distinctions in measured data between the black and white membranes are reproted. Included are cumulative and instantaneous heat fluxes and hourly surface temperature variations. Peak membrane temperatures were observed to differ by up to 50{degree}F during the day. Nighttime differences in membrane surface temperatures were negligible. Changes due to dirt accumulation and local environmental factors were observed in surface reflectance values calculated from the energy balance at the roof membrane and from reflectometer measurements. The experimental results reported here are currently being used to validate numerical modeling of surface effects upon roof system performance and building energy requirements. The results of the modeling and analysis efforts will be reported in a subsequent paper. 20 refs., 11 figs., 3 tabs.

30466 (CONF-8605117—, pp 181-186) **Pipeless ground-coupled heat pump system.** Spryszynski, Z.S. 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

At the present time people are trying to replace oil by new heating systems. Instead of energy from the enormous oil fields in the Far East we can take the major share of thermal energy from ground and outdoor air. This paper offers a method of utilizing low-temperature ground energy, outdoor air energy, solar energy and household waste energy to supply heat for heat pumps and to preheat and precool intake air, for space heating and cooling, in a new, simple and cheap way.

30467 (CONF-8709111—2) **An overview of the building energy retrofit research program.** Mixon, W.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007274/JAW.

From 4. annual symposium on improving building energy efficiency in hot and humid climates; Houston, TX, USA (15 Sep 1987).

A relatively new program of the US Department of Energy has been established to focus on the technical, financial, and behavioral barriers to improving the energy efficiency of existing buildings through retrofit. The program is organized by the three building sectors (single-family, multi-family, and commercial) and is implemented with expertise from four national laboratories, Princeton University, and the Alliance to Save Energy in cooperation with a large number of state, utility, and local agencies. This paper summarizes the objectives, approach, and accomplishments of the program.

30468 (CONF-8709187—) **Proceedings of the technical exchange meeting on passive radon monnitoring.** Duray, J.R.; Langner, H. Jr.; Martz, D.E. (UNC Geotech, Grand Junction, CO (USA). Technical Measurements Center). Sep 1987. Contract AC07-86ID12584. 167p.

From Technical exchange meeting on passive radon monitoring; Grand Junction, CO, USA (21 Sep 1987).

The purpose of the meeting was to bring together a number of scientists active in the development and use of passive radon monitoring instrumentation, primarily activated charcoal detectors and alpha track detectors. Many of those present expressed a desire to receive copies of the viewgraphs and other materials presented. Most have supplied extended abstracts or complete reports. These materials are reproduced here as a Technical Measurements Center Report for the benefit of those attending the meeting and for others interested in passive radon monitoring. Individual papers were processed separately for the data base.

30469 (DOE/BP/11287—13-Vol.2) **The Hood River Conservation Project: The Hood River story: Marketing a conservation project: Volume 2, Final report.** Kaplon, S. (ed.). (Pacific Power and Light Co., Portland, OR (USA)). Mar 1988. Contract AC79-83BP11287. 87p.

This report presents the marketing efforts behind the Hood River Conservation Project (the Project). The Project was a research effort designed to identify and systematically document the effects and retrofit potential of conservation when rapidly implemented within a limited geographic area. Super-weatherization measures were installed in 85 percent of all qualified households at virtually no cost to the homeowner. The goals of the project were to determine the maximum penetration rate of weatherization participation and measures within a limited period of time; the relative effectiveness of various approaches to conservation marketing; the characteristics of community social interaction and impacts under maximum conservation conditions; the costs associated with the development and conduct of a maximum conservation effort; and the effects of conservation on distribution and transmission systems, load management, and savings. The purpose of this volume is to present the marketing efforts of the Project (drawing from the community assessment, marketing plan, and promotional plan) and their impact in achieving program goals (defined as participation, measures penetration, and pre- and posttest survey results). 20 refs, 8 figs., 10 tabs.

30470 (DOE/BP/11287—17) **The Hood River Conservation Project: Load analysis: Final report.** Stovall, T.K. (Pacific Power and Light Co., Portland, OR (USA)). Mar 1988. Contract AC79-83BP11287. 117p. (ORNL/CON—240).

As a part of the Hood River Conservation Project (Project), 314 homes were monitored to measure electrical energy use on a 15-minute basis. The total electrical load, space heating load, water heating load (in about 200 homes), wood-stove heat output (in about 100 homes), and indoor temperature were monitored. Data were collected for one full year before and one full year after these homes were retrofit with conservation measures. Weather stations were used to collect detailed local weather information, also on a 15-minute basis. This data base was used to evaluate the load savings attributable to Project. Two methods of weather normalization were used and showed close agreement. The weather-normalized diversified residential load savings on the Pacific Power and Light system and Hood River area peak days were greater than 0.5 kW/household. The average wintertime load savings were 0.4 kW/household. Savings were larger in single-family electrically heated homes where the average demand reduction was 0.6 kW/household and the diversified seasonal peak was reduced by 0.8 kW/household. The average spring, summer, and fall savings were much smaller, less than 0.1 kW/household. The load factor for the diversified residential load decreased following the conservation retrofit actions. A three-phase feeder was also monitored to measure the effect of the program. No such effect was measured on the feeder because of the confounding effect of unmeasured commercial loads and the timing of retrofit applications for residential customers on the feeder.

30471 (DOE/BP/24689—3) **An assessment for the self-evaluation of Phase 1: Energy-efficient appliance promotion campaign: Final report.** (Columbia Information Systems, Portland, OR (USA)). 12 Nov 1987. Contract AC79-86BP24689. 74p.

This paper contains the evaluation of the evaluation of a program conducted by the Bonneville Power Administration to encourage use of energy efficient appliances. (JDH)

30472 (DOE/CE—0166-Vol.4) **Lighting Prescriptive and System Performance Compliance Calculation Program documentation: Version 1.0: In support of proposed interim energy conservation standards for new commercial and multifamily highrise residential buildings.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Building Systems Div.). Nov 1986. 45p. NTIS, PC A; S 03;3. Order Number DE87004562/JAW.

Report includes 1 diskette designed to run on IBM PC or compatible equipment.

The microcomputer Lighting Prescriptive and System Performance Compliance Calculation Program is part of the Proposed Interim Energy Conservation Standards for New Commercial and Multifamily High Rise Residential Buildings. The program may be used for performing the calculations required for the lighting prescriptive and system performance requirements and compliance calculations in Sections 3.4 and 3.5 of the Standards. The microcomputer program is provided as a convenience in determining lighting requirements and calculating if a building design is in compliance with those requirements. The program will perform calculations for a maximum of 500 separate spaces in a building. This User's Guide contains instructions for using the program, a list of the building type and space type codes incorporated into the program, and a listing of the Pascal source code for the program.

30473 **(DOE/EA—0300) Support of proposed interim energy conservation standards for new federal residential buildings: Environmental assessment.** Wilfert, G.L.; Callaway, J.W.; Droppo, J.D.; Lee, A.D.; Parker, G.B.; Namekata, T.; Pratt, R.G.; Westergard, E.J.; Young, J.K. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Building Services Div.). Jul 1986. 202p.

This environmental assessment is a study done in support of the Standards and Guidelines Program, of the Architectural and Engineering Systems Group, Building Systems Division. The Energy Conservation Standards Act of 1976, as amended, requires the Department of Energy (DOE) to issue performance standards for the design of new buildings. These standards are to be mandatory for the design of new Federal buildings and voluntary for all other buildings. The DOE has divided the developemnt of these standards into two parts, residential buildings and commercial buildings. The residential building portion has been futher divided into Federal buildings due to the specialized nature of Federal residential buildings, which primarily house military personnel, and the method used to procure housing. This environmental assessment supports the Federal Residential Buildings Energy Conservation Standard portion of that program. It specifically supports the issueance of a Notice of Proposed Rulemaking (NOPR) for the Federal Residential Building Standards, which is a step in developing the Interim Federal Residential Building Standards intended to permit the broadest public comment and input to te stnadard under development.

30474 **(EPRI-EM—5730) Cold air distribution design guide: Final report.** Dorgan, C.E.; Elleson, J.S. (Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1988. 173p. Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number TI88920243/JAW.

This design guide describes the concepts and technology for using cold air distribution to cool commercial and industrial buildings. Cold air distribution systems provide primary air for comfort conditioning or process cooling at nominal temperatures between 38 and 51{degree}F. The use of lower temperature primary air allows distribution equipment to be downsized, resulting in lower first costs, and often lower energy costs. Cold air distribution has been applied primarily to take full advantage of the 34{degree}F-38{degree}F chilled water available wih ice storage systems. The concept is also applicable to chilled water storage and conventional, non-storage systems, especially in the range of 48{degree}F-51{degree}F nominal supply temperatures. This guide discusses the following aspects of cold air distribution: design approaches; factors influencing design; equipemnt selection; controls; design methodology; first-cost comparison of conventional and cold air systems, and comparison of energy consumption and operating costs for various cold air distribution approaches. 35 refs., 18 figs., 21 tabs.

30475 **(LBL—21144) The exponential scheme for computation of natural convection flow in enclosures.** Huang, Lan Chieh. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 27p.

In this paper the exponential scheme for multi-dimensional unsteady problems is discussed; a basis for approximation of solution is given and a boundary exponential scheme is derived. It is applied to the computation of natural convection in a square cavity with moderate size uniform grid for future calculation of air flow in enclosures and heat flux at walls in building energy analysis. The numerical method for the Boussinesq equations is based on the Marker and Cell (MAC) method and is put into conservation form via the Spalding-Patankar flux. The latter method is also discussed. Preliminary numerical tests show that the method is promising. 15 refs., 9 figs., 2 tabs.

30476 **(LBL—24292) Center for Building Science: Annual report, FY 1986.** Cairns, E.J.; Rosenfeld, A.H. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 171p.

The Center for Building Science consists of four programs in the Applied Science Division: energy analysis, buildings energy systems, windows and lighting, and indoor environment. It was established to provide an umbrella so that goups in different programs but with similar interests could combine to perform joint research, develop new research areas, share resources, and produce joint publications. As detailed below, potential savings for the U.S. society from energy efficient buildings are enormous. But these savings can only be realized through an expanding federal R&D program that develops expertise in this new area. The Center for Building Science develops efficient new building componenets, computer models, data and information systems, and trains needed builidng scientists. 135 refs., 72 figs., 18 tabs.

30477 **(ORNL/CON—248) Evaluation, modification, and deployment of the ECOP-II computer program.** MacDonald, J.M.; Gettings, M.B.; Goldenberg, D.; Wasserman, D.M. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 71p.

This project, conducted at Oak Ridge National Laboratory (ORNL), covered the evaluation and modification of teh ECOP-II computer program. The project also included the development of recommendations on the deployment of ECOP-II. The ECOP-II computer program (Energy Conservation Opportunity Program for small commercial and light industrial buildings) was previously developed under direction of the U.S. Air Force. This report presents the results of data gathering efforts at 11 military installations, reviews of algorithms and calculations, the validation analysis of ECOP-II, and recommendations on general use of ECOP-II, personnel requirements, and related recommendations for energy management efforts at military bases. Some additional effort to correct remaining problems with ECOP-II is needed before considering the program ready for field use. Limited field use of the program can be started with the understanding that the results should still be checked to see if they make sense.

30478 **(ORNL/CON—250) An analytical investigation of energy end-use in commercial office buildings: Topical report.** McLain, H.A.; MacDonald, J.M.; Downing, D.J. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 186p. (GRI—87/0318).

The purpose of this study is to analyze the end-use energy behavior of commercial office buildings. It is not intended as a complete study, but a preliminary study. The energy use data files were created using the DOE-2.1B building simulation program using weather data for Chicago, IL, Fort Worth, TX, and Miami, FL. Fractional factorialdesing methodology was used to select the independent parameters for each computer run and to rank the importance of the parameter effects. The analysis was done for three different size buildings located in the three cities. The buildings are: 1) a single story 2500 sq. ft. building, 2) a three story building with 49,500 sq. ft. of floor area, and 3) a ten story building with 200,000 sq. ft. of area. All buildings have flat roofs and concrete slab floors. The floors are carpeted. The exterior surfaces are lightweight concrete; 30{percent} of the wall surface is glazing. Results of the calculations performed, with analysis of their importance, are presented in this volume. 23 refs., 32 figs., 10 tabs.

30479 **(ORNL/Sub—85-06613/1) Weatherizing homes in Portland: An evaluation of a community-based partnership residential conservation pilot program.** Morgan, S.J. (Technical Development Corp., Boston, MA (USA)). Feb 1988. Contract AC05-84OR21400. 42p.

Twelve public and private organizations serving Portland, Maine collaborated to establish a comprehensive, one-stop residential conservation program model during the fall and winter of 1984-5. The Weatherize Portland Planning Task Force launched a demonstration program to test the model in two neighborhoods from February to May 1985. In September 1985 the U.S. Department of Energy (DOE) funded an evaluation of the planning process and the demonstration program. The Technical Development Corporation, with two subcontractors{emdash}Energy Systems Research Group and Einstein Consultants{emdash}have undertaken this evaluation. The evaluation team operated in the context of the following goals set forth by the Maine Office of Energy Resources, which convened the Portland Task Force: (1) to promote the use of and improvement in the RCS audit; (2) to provide hands-on training in the installation of low cost infiltration measures; (3) to stimulate additional purchase of low cost measures by providing a free kit of conservation materials; (4) to generate loans for energy improvements; (5) to coalesce existing program providers in the offering of a more comprehensive and coordinated package of services; and (6) to gain experience in the planning and implementation of a weatherization program. The planning participants requested the evaluation before committing additional resources to an expanded Maine program; DOE was also interested in program model refinements and potential applications in other communities. This evaluation investigates the nature and extent of participation in the program, probes the demonstration program's strenghts and weaknesses, and makes recommendations for improving the model for future adaptions in Maine and elsewhere.

30480 **(ORNL/Sub—85-22035/1) Field performance validation of an advanced design earth-coupled heat pump system.** Hughes, P.J.; Hackner, R.J. (Fleming (W.S.) and Associates, Inc., Syracuse, NY (USA)). Jan 1988. Contract AC05-84OR21400. 105p. NTIS, PC A; 06/MF A01; GPO Dep. Order Number DE88007842/JAW.

Oak Ridge National Laboratory, Niagara Mohawk Power Corporation, and W.S. Fleming and Associates, Inc. conducted a field-test program to evaluate prototype earth-coupled heat pump systems in two upstate New York homes. Each site utilized a prototype liquid-source heat pump designed specifically for the earth-coupled application. One-pipe and two-pipe-per-trench earth coils were used. The results show that the prototype heat pumps provided efficient operation at source temperatures as low as 27{degree}F, enabling significantly shorter earth loops to be installed. Earth loop cost savings were greater than the increased cost of the heat pump over standard models, resulting in a net decrease in overall system installed cost. 9 refs., 9 figs., 17 tabs.

30481 **(ORNL/Sub—86-55930/1) Determination of radiative properties of fiberglass and foam insulations.** Yajnik, S.; Roux, J.A. (Mississippi Univ., University (USA). Dept. of Mechanical Engineering). Dec 1987. Contract AC05-84OR21400. 179p.

The spectral radiative properties of 1450(b) high density fiberglass, 1451 low density fiberglass, and expanded polystyrene were inverted from monochromatic directional-hemispherical reflectance and hemispherical-directional reflectance data coupled with an analytical model in the wavelength range of 4 to 40 microns. A set of ten samples were prepared for each of the three insulation materials. The Willey 318S Fourier transform spectrometer (DTS) was utilized to measure the directional-hemisherical reflectance data in the wavelength range of 2-20 μm for the three sample sets. The hemispherical-directional reflectance data for the two fiberglass samples sets were obtained with a hemiellipsoidal reflectometer in the wavelength range of 4-40 μm. From the directional-hemispherical reflectance data, the spectral absorption and scattering coefficients were inverted for the three test insualtions using the non-linear least squares approach coupled with Chandrasekhar's discrete ordinates solution of the radiative transport equation. These radiative properties together with the true thermal conductivity values for fiberglass and foam insulations were used to compute typical heat transfer results which were then compared to experimental data where available. An optimization analysis was conducted for the fiberglass insulations to determine the bulk density at which the steady-state heat transfer through the fiberglass layer insulation was a minimum. 32 refs., 37 figs., 19 tabs.

30482 **(PB—88-171277/XAB) Energy-use testing of domestic refrigeration appliances. Part 2 of a project to design and demonstrate an energy-efficient kitchen.** Stockwell, D.; Hazlewood, L.; Morgan, D. (Massey Univ., Palmerston North (New Zealand). Food Technology Research Centre). Oct 1987. 62p. NTIS, PC E04/MF A01.

An investigation was carried out to determine the energy consumption of domestic refrigerators on the New Zealand market. A cross section of refrigerators from the various classes were selected for testing. Within these classes the most popular models of the Kelvinator, Prestcold, and Simpson range were chosen. It was found that differences in energy consumption resulted from different manufacturers and models within the same class of refrigerator.

30483 **(PB—88-171897/XAB) Doors and windows in natural climate.** Brolin, H.; Gustafsson, M. (Statens Provningsanstalt, Boraes (Sweden)). 1988. 91p. (In Swedish). (SP-RAPP—1988:04). NTIS, PC E04/MF A01.

Tests of functional properties such as air tightness and closing force of entrance doors are normally done on new products at room temperature. In order to study the effect of natural climate, tests have been conducted on five different types of entrance doors by the National Testing Institute and the Swedish Institute for Wood Technology Research. Climate tests were performed in the laboratory and the doors were mounted in the south and north facades of test houses in Boras and Skelleftea. The following properties were measured: flatness of doorleaves; gap width between frame and doorleaf; air tightness; closing force and general condition.

30484 **(PB—88-173414/XAB) Sick schools: an investigation into the prevention of aspecific health complaints by school children in relation to the carbon dioxide level in the indoor climate.** van de Sandt, P.; Potting, J.; Dijkhof, E.H. (Wageningen Gezondheidsleer (Netherlands)). Feb 1987. 90p. (In Dutch). (REPT—1987-281). NTIS, PC E04/MF A01.

30485 **(PNL-SA—14101) Multivariate statistical assessment of meteorological influences on residential heating requirements.** Hadley, D.L.; Tomich, S.D. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1986. Contract AC06-76RL01830. 19p. (CONF-860818—18).

From American Council for an Energy Efficient Economy Santa Cruz summer study on energy-efficiency in buildings; Santa Cruz, CA, USA (17 Aug 1986).

The relationship between residential space heating in four residences in the Pacific Northwest and the external meterological determinants of the space heating variability were investigated using the multivariate statistical techniques of principal component analysis (PCA) and stepwise regression analysis. The PCA identified 3 significant, uncorrelated components that were linear combinations of the 6 original meterological variables. The first component, dominated by the outdoor temperature, accounted for between 63% and 72% of the variability in the original meteorological data and explained between 55% and 87% of the variability in the daily total space heating consumption. The first 3 principal components combined to explain over 95% of the variability in the data and up to 90% of the variability in the space heating. 8 refs., 3 figs., 6 tabs.

30486 **Analysis of air-conditioning controls for Building 4500 South, Oak Ridge National Lab.** Hamblen, S.E. pp 341-345 of Integration of efficient design technologies. Payne, F.W. (ed.). Lilburn, GA; Fairmont Press, Inc. (1988). Contract AC05-84OR21400.

Reports of unstable zone temperatures throughout Building 4500 South at the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee, resulted in a study of the control systems of the

four main air-conditioning units that service the building. The purpose of this study was to determine the source of the problem and to make recommendations for correcting the situation. All four units are 100% outdoor air heating and cooling units with airflows of 115,000 CFM, 103,000 CFM, 67,000 CFM, and 146,000 CFM respectively. The study concluded that the controls for the units involved in this study were accessible to too many people and the maintenance performed was to treat the symptoms and never to determine the real problem. Adequate information is required from the control system and the air-handling equipment in order to evaluate the symptoms and determine what is really wrong with the controls. When new building control systems are designed, the temperature and pressure display requirements should include the information that is necessary for trouble-shooting the control system, not just the information that is required to control the space temperature. The additional cost of these temperature and pressure sensors will be returned in reduced energy use when problems such as those discovered in this study are prevented.

30487 **Real world financing opportunities for energy conservation projects.** Tramonte, D.J. pp 575-576 of Integration of efficient design technologies. Payne, F.W. (ed.). Lilburn, GA; Fairmont Press, Inc. (1988).

In 1987, there is no Energy Tax Credit, no Investment Tax Credit, no Accelerated Cost Recovery System depreciation. There is a more realistic approach to true energy financing. Investment dollars for energy projects are based on the economic viability of the project, saving money for the client or user, and a fair profit for the contractor or service provider. Financing alternatives discussed are: shared savings, commercial lease, and municipal lease/purchase.

30488 **Radioluminescent lights score high in VFR (visual flight rules) night air taxi tests.** Jensen, G.A.; Leonard, L.E.; Powell, J.A. (Pacific Northwest Lab., Richland, WA (USA)). *Northern Engineer;* **19**: No. 1, 6-16(Spr 1987). Contract AC06-76RL01830.

Alaska and other far northern areas have logistical, environmental and economic problems that make tritium-powered radioluminescent (RL) lighting, especially at airfields, an attractive alternative to electrical systems and flare pots. RL lights have been under development by the US Department of Energy (DOE) for use in tactical operations and wherever electrical utility or portable power is unavailable or difficult and uneconomical to obtain. The lights were tested by pilots, as described here, specifically to provide a formal initial evaluation of an RL runway lighting system that could lead to FAA approval for use in nighttime aircraft operations under Part 135 of the Federal Aviation Regulations (FAR). All testing was completed under high-visibility visual flight rules (VFR) conditions (10 statute miles or greater). The FAA test supervisor concluded that the RL system was acceptable under the good meteorological conditions prevailing then. However, more testing will be needed at or near VFR minimums (2- to 3-statute mile visibility) before full approval is obtained. Pilots' responses in this test and in other tests have provided much information and given incentive to the development of RL lights.

30489 **Cooling energy and cost savings with daylighting in a hot and humid climate.** Arasteh, D.; Johnson, R.; Selkowitz, S.; Connell, D. (Lawrence Berkeley Lab., CA (USA)). *Sunworld;* **10**: No. 4, 104-109, 128(1986).

Fenestration performance in nonresidential buildings in hot climates is often a large cooing load liability. Proper fenestration design and the use of daylight-responsive dimming controls on electric lights can, in addition to drastically reducing lighting energy, lower cooling loads, peak electrical demand, operating costs, chiller sizes, and first costs. The information presented is based on results from building energy simulations, and discusses lighting energy savings from daylighting. The effects of fenestration parameters on cooling loads, total energy use, peak demand, chiller sizes, and initial and operating costs are also discussed. Finally, the impact of daylighting, as compared to electric lighting, on cooling requirements is discussed as a function of glazing characteristics, location, and shading systems.

3202 Transportation

REFER ALSO TO CITATION(S) 30417

30490 **(ANL/ES—152) Indirect energy use in urban passenger transportation: A comparative analysis.** Singh, M.K. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 55p.

The indirect energy requirements of urban passenger transportation - vehicle manufacture, infrastructure construction, fuel production, and vehicle and roadway maintenance - can represent a significant percentage of the total energy required for a given transportation project or strategy. The literature on indirect energy use, however, presents a wide range of estimated values for each of these requirements. This analysis examines five studies or groups of studies, which provide estimates of the various components of indirect energy use in urban transportation, in an effort to explain the bases for the differences that exist among various estimates and to reconcile the estimates where possible. The currect study concludes that the most significant reason for substantial differences is that each previous estimate has used one of two different methodological approaches. Values derived using an input/output (I/O) analysis approach are almost always substantially higher than those derived using a process analysis approach. Further, within those studies that are based on process analysis, substantial variation occurs because of different assumptions regarding vehicle or roadway material characterizations and estimated energy required to produce specific materials. These latter differences result from varying assumptions regarding material recycling rates, production efficiency gains over time, and material import rates. Finally, the study concludes that the available estimates cannot at this time be resolved into definitive values for vehicle production, infrastructure construction, fuel production, and maintenance activities; it recommends further study and evaluation. Ideally, a consensus should be developed on a single methodology to be followed in indirect energy analysis; it is the author's belief that the process-based approach is preferable to the I/O approach.

30491 **(PB—88-173562/XAB) Relatinship between road surface and fuel consumption on gravel roads.** Saevenhed, H. (Statens Vaeg- och Trafikinstitut, Linkoeping (Sweden)). 1987. 41p. (In Swedish). (VTI—235). NTIS, PC E03/MF A01.

The purpose of the investigation was to study differences in fuel consumption between two consecutive reshapings with a grader of a gravel road in central Sweden; thereby obtaining part of the data required to draw up criteria for when or how often a gravel road requires reshaping with grader.

30492 **(UCID—21389) A simulation of post boost vehicle deployment of multiple reentry vehicles.** Sholl, P.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1988. Contract W-7405-ENG-48. 32p.

This report summarizes the equations and assumptions used to develop the model for PBV (post boost vehicle) deployment of multiple reentry vehicles for the Block I and Block II simulation effort by the R-program Weapons Concept Group. 7 figs., 8 tabs.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 29949, 30448, 30539, 30614, 31215

30493 **(DOE/BP/31023—1) Energy savings in a silicon furnace through improved reductant technology: Final report for evaluation of charcoal and coalchar.** (Dow Corning Corp., Springfield, OR (USA)). 22 Dec 1987. Contract AC79-86BP31023. 36p.

A two-week smelting test using coalchar was performed from February 20th to March 7th, 1987 in Dow Corning's 25,000 kva submerged arc silicon furnace. A specific energy consumption of 5.68 kwh/lb was obtained over the test period compared favorably to a historic specific energy consumption of 6.4 kwh/lb. Test results indicate a 4.7% cost savings vs. 1987 standard cost could be achieved assuming demonstrated coal char performance can be

maintained on an annual basis. A smelting test using charcoal was conducted from September 1 through September 14, 1987 in Dow Corning's 25,000 kva submerged arc silicon furnace. A specific energy consumption of 5.60 kwh Si was obtained during the test also compared favorably to a historic specific energy consumption of 6.4 kwh/lb Si. The observed energy consumption was slightly lower than the 5.68 kwh/lb Si specific energy consumption observed during the coalchar test earlier in 1987. These test results indicate a 5.73% cost savings vs 1987 standard budget cost could be achieved assuming demonstrated performance can be maintained on an annual basis. This savings is better than the 4.73% projected for coalchar. This study recommends commercialization of charcoal technology at the Springfield site. This recommendation of charcoal technology at the smelting process, lower projected manuafacturing cost for Si and the availability of the reductant. 6 refs., 4 figs., 7 tabs.

30494 **(DOE/CE—8006612) Steel initiative management plan.** (Department of Energy, Washington, DC (USA). Office of Industrial Programs). Apr 1988. 17p.

The Steel Initiative embraces the entire flow sheet associated with the prodution of primary steel products, from ore reduction to cold finishing inclusively. The broad objective of the research is the elimination or the reduction of costly unit processes, in order to significantly improve the productivity of steelmaking. This research is expected to be high risk; incremental improvemnts in existing processes are not being sought. Areas of possible research are described, as is the status of the Steel Initiative research. Issues, solutions and recommendations are discussed.

30495 **(DOE/ID/12170—3) High-temperature burner-duct-recuperator (HTBDR) development and demonstration: Final report for the period October 1981-September 1987.** Strumpf, H.; Hossepian, G.; Coombs, M.; Kotchick, D. (Allied-Signal Aerospace Co., Torrance, CA (USA). AiResearch Los Angeles Div.). Dec 1987. Contract FC07-81ID12170. 709p.

A program has been completed to design, develop, fabricate, install, operate, and evaluate a high-temperature burner-duct-recuperator (HTBDR) system. The HTBDR is used to recover waste heat from industrial furnaces through preheating of the combustion air. The HTBDR comprises a high-termperature ceramic tubular recuperator operating in series with a metallic plate-fin heat exchanger, a high-termperature dual-fuel burner, and the associated ducting, controls, and auxiliary equipment. After generating a full-size preliminary design, a scaled-down prototype HTBDR was designed, developed, fabricated, and successfully tested. The HTBDR produced 2000{degree}F air with exhaust gas at approximately 2350{degree}F. Prototype burners operated with the 2000{degree}F air. Following the prototype test, the full-size final design was prepared. The system was fabricated and installed on a rotary heat treating furnace at Cameron Iron Works, Houston, Texas. The system operated successfully for about 6 months. The HTBDR demonstrated air preheat capability of over 1900{degree}F (with 2100{degree}F exhaust gas). The system was eventually shut down due to the structural failure of a few ceramic components (not the ceramic tubes). Faulty fabrication of the failed parts coupled with severe and numerous thermal cycling was judged to be the source of this problem.

30496 **(DOE/IEC—88/1) Industrial Energy Conservation: A current awareness bulletin.** Williams, L.E. (ed.). (USDOE Office of Scientific and Technical Information, Oak Ridge, TN). Jan 1988. 34p.

Industrial Energy Conservation (IEC) announces on a monthly basis the current worldwide information on all aspects of energy conservation in industry, including alternate energy sources; improved materials, equipment, and processes; waste heat recovery; and industrial waste management. This publication contains the abstracts of DOE reports, journal articles, conference papers, patents, theses, and monographs added to the Energy Data Base (EDB) during the past month. Also included are US information obtained through acquisition programs or interagency agreements and international information obtained througn the International Energy Agency's Energy Technology Data Exchange or government-to-government agreements.

30497 **(EGG-EP—7635) Research and development opportunities in the area of industrial drying.** Lawford, T.W.; Bradburn, H.F.; Evans, D.R.; Fullmer, K.S.; Naretto, C.J.; Reimann, G.A.; Semler, T.T.; Thompson, W.N. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 155p.

This study has been conducted for the purpose of identifying research and development opportunities that, when implemented, would save energy in the area of industrial drying. Efforts were concentrated on eight industries, which use 85{percent} of the total energy used for industrial drying. 7 figs., 5 tabs.

30498 **(MLM—3489) Technology update-86: Production technology and quality assurance.** Fitzharris, P.A. (ed.). (Monsanto Research Corp., Miamisburg, OH (USA)). Aug 1986. Contract AC04-76DP00053. 22p.

The six papers in this issue of Technology Update provide examples of the kinds of topics relating to both producitivity and quality. Reel-to-reel processing, with its labor and quality advantages, is discussed in the first paper, which deals with the manufacture of flexible circuits. A method for disposing of hazardous waste, a concern to production and environmental types alike, is presented in the paper on the Mound Glass Melter. Quality control per se in its statistical aspects is covered in yet another aritcle. A particularly successful application of bar coding technoogy, which benefits the accuracy of data and the speed of data transfer, is documented. And, finally, two papers touch on completely different aspects of our CIM (computer integrated manufacturing) effort. One addresses the installation of a Local Area Network, which enhances productivity through enhancing communications; the other describes a Flexible Machining Cell, used to manufacture small volume lots of product with NC programs, in which huamn error has been practically eliminated.

30499 **(PB—88-173547/XAB) Design and operation of hot-air dryers for the drying of granular activated carbon.** van Staden, P.J.; Cole, P.M. (Council for Mineral Technology, Randburg (South Africa)). 24 Nov 1987. 32p. (MINTEK-M—331). NTIS, PC E03/MF A01.

Summary in Afrikaans.

The thermal regeneration of activated carbon involves both the removal of water and the regeneration of carbon at high temperature. A significant amount of energy can be saved by the predrying of the carbon prior to the regeneration step. The design and operation of both pilot-scale and industrial-scale hot-air dryers is discussed. A procedure for the selection of a dryer and blower combination is suggested, and a computer program that performs this function is described. Details of the theoretical and practical energy required for hot-air drying are given. The results of the investigation indicate that a saving in energy of up to 23% can be gained by the use of a pre-drying step prior to the regeneration step.

30500 **(PB—88-176078/XAB) Metal-value recovery from metal hydroxide sludges: removal of iron and recovery of chromium. Final report, October 1985-July 1987.** Twidwell, L.G.; Dahnke, D.R. (Montana Coll. of Mineral Science and Technology, Butte (USA)). Mar 1988. 222p. NTIS, PC A10/MF A01.

The report describes the application of commercially developed hydrometallurgical processes to the recovery of metal values from complex metal finishing hydroxide sludges. Information in the report will be useful to the electroplating and waste-disposal industries in general and to other industries responsible for treatment and disposal of metal-bearing process solutions.

30501 **(PB—88-183033/XAB) Cost reduction in the manufacture and installation of gas-fired prepackaged cogeneration systems. Final report, August 1986-November 1987.** Mulloney, J.A. (Mueller Associates, Inc., Baltimore, MD (USA)). Nov 1987. 250p. NTIS, PC A11/MF A01.

The capital cost of cogeneration installations is a significant economic factor in the purchase decision process. While prepackaging (mounting most or all system components on a skid) provides a means of cost reduction through standardization and volume manu-

facture in the size range of 50 kWe to 500 kWe, published reports of the initial installations of these units have indicated a higher-than-expected total installed cost. The objectives of the project were to: (1) Develop a cost data base of existing prepackaged cogeneration sites; (2) Identify and evaluate cost-reduction concepts/approaches, and (3) Estimate future total installed costs. A cost data based on 53 sites meeting prepackaged technical requirements was developed from mail questionnaire, site visit, and manufacturer data. These data indicated an average total installed cost of $1,344/kWe with a range from $600 to $2,800/kWe. Various analyses, site visits, and discussions with a very wide range of involved personnel, including a workshop of key individuals representing manufacturers, installers, developers, designers and others, provided insight about the cost structure and the key cost drivers. A detailed component by component manufacturing cost-estimating procedure was used to estimate factory costs for various size units and levels of production.

30502 **(PB—88-861430/XAB) Solid-waste reclamation and recycling: plastics. January 1970-March 1988 (citations from the NTIS data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 93p. NTIS PC N01/MF N01.

Supersedes PB—83-807636.

This bibliography contains citations concerning the recovery of plastic wastes. Urban and industrial recycling programs are discussed. Plastics decomposition into reusable chemicals and the use of recycled plastic in new products are discussed. The economics of plastics recycling programs and participation in them are briefly included. (This updated bibliography contains 176 citations, 35 of which are new entries to the previous edition.)

30503 **(PB—88-862008/XAB) Metals recovery from wastes. January 1977-April 1988 (citations from the Selected Water Resources Abstracts data base). Report for January 1977-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 147p. NTIS PC N01/MF N01.

Supersedes PB—87-859427.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially waste waters. (This updated bibliography contains 279 citations, 35 of which are new entries to the previous edition.)

30504 **(PB—88-862115/XAB) Metals recovery from wastes. June 1970-April 1988 (Citations from the Engineering Index data base). Report for June 1970-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 134p. NTIS PC N01/MF N01.

Supersedes PB—87-859658.

This bibliography contains citations concerning the recovery and recycling or reuse of ferrous and nonferrous metals from various industrial wastes, especially waste waters. (This updated bibliography contains 334 citations, 30 of which are new entries to the previous edition.)

30505 **(PNL—6552) Separations innovative concepts: Project summary.** Lee, V.E. (ed.). (Pacific Northwest Lab., Richland, WA (USA)). May 1988. Contract AC06-76RL01830. 114p.

This project summary includes the results of 10 innovations that were funded under the US Department's Innovative Concept Programs. The concepts address innovations that can substantially reduce the energy used in industrial separations. Each paper describes the proposed concept, and discusses the concept's potential energy savings, market applications, technical feasibility, prior work and state of the art, and future development needs.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 30278, 30501, 31115

30506 **(ANL—87-60) Acoustic leak detection for district heating systems.** Kupperman, D.S.; Karvelas, D.E. (Argonne National Lab., IL (USA); Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 43p.

An acoustic leak detection facility was completed and used to evaluate the capability of piezoelectric sensors, accelerometers, and capacitance microphones to detect and locate gas and water leaks in underground district heating and cooling (DHC) piping. Leak detection sensitivity and location capabilities for DHC systems were estimated from laboratory data and from data obtained from the underground DH system in Scranton, Pennsylvania, where acoustic background noise levels and acoustic signals from field-induced steam leaks were acquired. Acoustic detection of leaks with flow rates of less than 10 gpm is possible at a distance of several hundred meters, with a location accuracy of a few meters. Although steam leaks of comparable mass loss can be detected over a similar range with transducers mounted on the pipe outer wall, location accuracy of a few meters over this range may only be possible with transducers in direct contract with the steam. Intrusive sensors may also be necessary to detect and locate leaks in plastic pipe. 10 refs., 26 figs., 3 tabs.

30507 **(EPRI-P/EM—5631) DSM [Demand-Side Management] regulatory impacts: Final report.** Kirksey, W.E.; Balistocky, S.; Miller, B.; Jones, D.; Cogan, D. (Battelle Columbus Div., OH (USA); Temple, Barker and Sloane, Inc., Lexington, MA (USA); Investor Responsibility Research Center, Washington, DC (USA)). Mar 1988. 102p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920273/JAW.

This report describes regulatory issues relating to DSM and provides guidelines to utilities for improving regulatory relations. The report summarizes results of a survey of state regulatory commissions and presents a case study of the regulatory relationship between Florida Power Corporation and the Florida Public Service Commission as a positive example. The material in the report ranges from qualitative guidelines to the specific responses of individual states to survey questions.

30508 **(INIS-mf—11173) Study of heat supply systems development.** Popyrin, L.S.; Fil'kov, V.M. (Energoproekt, Sofia (Bulgaria)). 1984. 11p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702353/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

Prospects for the development of centralized heat supply systems in USSR are briefly discussed and some results of a study of the main problems are presented. The problems include an improvement of the structure of heat supply systems; utilization of heat sources of new types such as nuclear power plants, and the construction of slewable thermal power plants using organic fuel, also reliability of heat supply and environmental aspects. The results indicate a decrease in the relative part of decentralized sources and further extensive development of heat supply systems, with a rapid growth of the share of nuclear heat supply sources, such as dual-purpose power plants, district heating and industrial heat supply nuclear plants.

30509 **(PB—88-185186/XAB) Conversion of municipal sludge to oil. (Journal version).** Lee, K.M.; Griffith, P.; Farrell, J.B.; Eralp, A.E. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). 1987. 9p. (EPA—600/J-87/289). NTIS, PC A02/MF A01.

Pub. in Jnl. of Water Pollution Control Federation 59, No. 10, 884-889(Oct 1987) See also PB—87-197547.

Thermal conversion of municipal sludge to oil was investigated as a viable alternative for ultimate sludge disposal due to generation of energy. The conversion process using water as a solvent was evaluated in a batch mode using primary and secondary municipal sludges. A well defined oil-separation procedure was developed

in the research. The oil obtained after thermal conversion was dark brown, solid at room temperature and liquid at above 50°C, with an average heat content of 9400 cal/g oil. The increase of oil mass and energy yields as a result of thermal reaction was 73 and 67% in the primary sludge, and 515 and 485% in the secondary sludge, respectively, all with 10.9% volatile solids content. Catalyst addition did not increase the oil mass and energy yields. Data showed that primary sludge in the thermal-conversion process.

30510 **Making the most of a great situation.** Rose, P.H. pp 287-288 of Integration of efficient design technologies. Payne, F.W. (ed.). Lilburn, GA; Fairmont Press, Inc. (1988).

The paper describes the activities of the Institutional Conservation Programs (ICP). In 1984 in cooperation with DOE and in consultation with a variety of organizations, the ICP developed a multifaceted program of grants, special projects, and association networking to enhance their ability to provide institutions the information they need to achieve effective energy management. The ICP attempts to find ways to maximize funding mechanisms and technical expertise. Some of these activities are described.

30511 **Successful participation in energy conservation.** Hoshide, R.K.; Rock, W.F. Jr. pp 289-294 of Integration of efficient design technologies. Payne, F.W. (ed.). Lilburn, GA; Fairmont Press, Inc. (1988).

The Energy Technology Engineering Center (ETEC) has been providing technical assistance to the US Department of Energy's Institutional Conservation Program over the past eight years. This paper provides an overview of how institutions, including schools and hospitals, can successfully participate in energy conservation. It provides listings of potential energy conservation measures (ECM's) and operating and maintenance items that may be incorporated. These listings may assist the institution in deciding what can be done in the area of energy conservation. The decision process, reasoning, and selection of energy conservation measures or projects will vary according to the energy conservation goals of the institution. A technical assistance report is prepared to provide the institution with a program for energy management. This report should estimate energy savings, cost of implementation, and simple paybacks of the various projects that may be suitable for the institution. Thoughts on how to prepare technical assistance reports are discussed. Included are reasons why ECM's are disapproved, and how to avoid the common pitfalls of poor reports. By avoiding these pitfalls, TA reports of excellent quality should be written.

30512 **Energy audits, information systems, and emerging technologies for energy conservation.** Looney, Q. pp 295-297 of Integration of efficient design technologies. Payne, F.W. (ed.). Lilburn, GA; Fairmont Press, Inc. (1988).

ENERGY information systems (EIS) are not new and need not be complicated. Energy management, to be effective under today's conditions, must be a well organized and comprehensive effort. Failure to recognize that actions taken to reduce energy consumption by one part of a complicated system may increase energy consumption or bring about some other negative impact elsewhere in the system is a common cause of ineffectiveness of energy conservation programs. Indeed, a vast array of energy conservation and fuel substitution opportunities is always available. The difficult task is to identify the optimum mix considering the costs and benefits associated with each set of actions together with the resources available. These costs, benefits, and resources must include the intangible (personal and organizational relationships inside and outside the organization) as well as the technical and economic. Energy management is the process of achieving a high level of knowledge of energy consumption patterns, a method for comprehensively identifying and analyzing new opportunities, and a means of stimulating human commitment. This paper discusses the information system that must lie at the heart of any well-developed energy management activity and suggests some candidate energy end-use retrofit technologies emerging for institutional buildings.

3209 Education And Public Relations

30513 **(PNL—6263) The role of market research in the commercialization of technology.** Ivey, D.L.; Smith, S.A. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 26p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007952/JAW.

The objectiv eof this report is to provide information on available empirical work that describes criteria used by the residential consumer market in selectign energy and energy-related products. This market is important to the US Department of Energy's (DOE) Office of Building and Community Services (OBCS), which sponsors the developement of many energy-conserving technologies ultimately used by the residential consumer. In this report, the consumer decision-making process is described, and case studies are presented to illustrate the importance of conducting systematic market research in the early stages of the technology-development process. Consumer decision making is examined through a discussion of the steps of the decision-making process: problem recognition, information search, evaluation of alternatives, and purchase decision. Post-purchase behavior and its implications to the OBCS and to commercial marketing research are also discussed. The four case studies that are presented in this report illustrate the importance of market research in building energy loss, lighting, water heating, and refrigeration: (1) low-emissivity (low-E) windows; (2) long life light bulbs; (3) heat pump water heaters; and (4) energy efficient refrigerator-freezer.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 29944, 30177, 30518, 30519, 30521, 30523, 30524, 30606

30514 **(DOE/CE—0212) Utilization of alternative fuels in diesel engines:.** (Pennsylvania State Univ., University Park (USA)). Jun 1987. Contract FG01-84CE50046. 199p.

The thrust of this resarch program has been to determine the effect of various alternative and synthetic fuels on the performance and emissions from Diesel engines. The purpose of research was to investigate the various fuels for extension of existing supplies or as emergency substitutes for Diesel fuels. Thus, the work did not emphasize optimization of the engines for a given fuel;the engines were generally run at manufacturers specifications for conventional fuels. During the various studies, regulated and unregualted emissions were investigated and the biological activity of the soluble organics on the particulate emissions was determined using the Ames test procedure. During the present contract period, three experimental programs were carried out. The first program investigated the utilization of methane and propane in an indirect injection, multicylinder engine. In the other two studies, a single cylinder direct injection Diesel engine was used to investigate the performance and emission characteristics of synthetic fuels derived from tar sands and oil shale and of three fuels derived from coal by the Exxon Donor Solvent (EDS) process. The body of this report consists of three chapters which summarize the experimental equipment, procedures, and major results from the studies of methane and propane fumigation, of synthetic fuels from oil shale and tar sands and of the coal-derived fuels.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 30395

30515 **(EGG-EP—7944) Test results of the Electric Vehicle Field-Laboratory Correspondence Program: Phase 1 report.** MacDowall, R.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Dec 1987. Contract AC07-76ID01570. 43p.

During the past decade a signficant number of venicles, batteries, and powertrain components have been evaluated by the US

Department of Energy (DOE) Electric and Hybrid Vehicle Program. These evaluation tests have been performed in dynamometer laboratories, on test tracks, and on the road under actual field operating conditions. Previous DOE-funded programs have developed several computer models which simulate electric vehicle performance over a wide range of operating conditions. This report presents the results of tests performed by EG and G Idaho, Inc., at the Idaho National Engineering Laboratory (INEL). The primary objective of the Electric Vehicle Field-Laboratory Correspondence Program is to significantly enhance the ability to predict field performance from laboratory test results, and to predict the behavior of vehicle systems not yet fabricated. A secondary objective of this program is to obtain "real-time based" data with the INEL Portable Data Acquisition system (PDAS) which can then be compared to the "event-based" test data acquired using the Versatile Data Acquisition System (VDAS). The VDAS-to-PDAS comparisons from these tests indicate the relative strengths and limitations of these rather different approaches to in-vehicle acquisition of engineering data. The conclusions of this first phase report indicate that the corresondence among the data acquisition systems was comparable to test-to-test repeatability, and that the energy consumption values matched closely among dynamometer, track, and tightly controlled road tests. 7 figs., 6 tabs.

30516 **(LBL—24639) Zinc-air design concept for the DOE-EHP IDSEP van.** Ross, P.N. Jr. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 20p.

The present Zn-air battery concept design exhibits some of the same characteristics as earlier versions of this battery, in particular, the energy densities of 100 to 110 Wh/kg and 50 to 60 Wh/L are typical of all the previous circulating electrolyte designs. These energy densities are much lower than the "golden rule" of 25% of the theoretical (894 Wh/kg), but this result is inherent in the fact that he electrolyte is really the active material rather than Zn metal (12 M KOH containing 260 g Zn/L has a theoretical energy density of 368 Wh/L or ca. 230 Wh/kg). The major departure of the present system from all other Zn-air versions is in the power density, electrical efficiency, cycle life, and cost. The new zinc electrode concept has eliminated the zinc electrode as a life limiting factor, and the improvements in power, efficiency, and cost have come from the improvements made in air electrode technology.The advantages of the Zn-air battery, as realized in this design for the IDSEP van, over other battery systems are: (1) energy capacity, exceeds the minimum by 50%; (2) low weight, less than maximum allowed weight by 50%; (3) minimal environmental impact and superior safety; (4) constructed entirely of common materials; (5) low materials cost, uncomplicated manufacture. The anticipated difficulties in realizing these advantages will be in sustaining the power required for acceleration over the lifetime needed for economic life-cycle cost. 8 refs., 3 figs.

3306 Vehicle Design Factors

30517 **(DOE/NASA/50162—2) Tribological properties of alumina-boria-silicate fabric from 25 to 850{degree}C.** Della-Corte, C. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1988. Contract AI01-86CE50162. 12p. (NASA-TM—100806). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007319/JAW.

Demanding tribological properties are required of the materials used for the sliding seal between the sidewalls and the lower wall of the variables area hypersonic engine. Temperature range from room temperature and below to operating temperatures of 1000 {degree}C in an environment of air, hydrogen, and water vapor. Candidate sealing materials for this application are an alumina-boria-silicate, ceramic, fabric rope sliding against the engine walls which may be made from copper- or nickel-based alloys. Using a pin-on-disk tribometer, the friction and wear properties of some of these potential materials and possible lubrication methods are evaluated. The ceramic fabric rope displayed unacceptably high friction coefficients (0.6 to 1.3) and, thus, requires lubrication. Sputtered thin films of gold, silver, and CaF_2 reduced the friction by a factor of two. Sprayed coatings of boron nitride did not effectively lubricate the fabric. Static heat treatment tests at 950 {degree}C indicate that the fabric is chemically attacked by large quantities of silver, CaF_2, and boron nitride. Sputtered films or powder impregnation of the fabric with gold may provide adequate lubrication up to 1000 {degree}C without showing chemical attack. 5 refs., 7 figs., 2 tabs.

3307 Emission Control

REFER ALSO TO CITATION(S) 30778

30518 **(PB—88-178421/XAB) Correlation testing of the European EMA (Engine Manufacturers Association) round-robin engine (Daimler-Benz OM 366a). Heavy-duty engine testing report. Technical report.** Baines, T.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1987. 29p. (EPA/AA/SDSB—88/04). NTIS, PC A03/MF A01.

This report examines the results of testing the Daimler-Benz OM 366 A heavy-duty engine at the Environmental Protection Agency Motor Vehicle Emission Laboratory. This heavy-duty engine was tested for the purpose of providing correlation data for the comparison with similar data developed by European Engine Manufacturers (EMA). The European EMA members organized a round robin testing program and decided to test a Daimler-Benz OM 366A engine, and to focus the program on gathering simple cold start/hot start Federal Test Procedure data. The report includes the results of the tests, including engine description, fuels, test procedures and test plans.

30519 **(PB—88-179312/XAB) In-use performance of Daimler-Benz light-duty diesel particulate-trap oxidizers. Technical report.** Baines, T.M.; Carlson, P.N. (Environmental Protection Agency, Ann Arbor, MI (USA)). Feb 1988. 30p. (EPA/AA/SDSB—88-02). NTIS, PC A03/MF A01.

Ten in-use 1985 Mercedes-Benz light-duty diesel vehicles equiped with particulate trap oxidizer systems and with mileages between 30,000 and 50,000 miles were tested for particulate (PM) and gaseous exhaust (HC,CO, CO_2, and NOx) emissions. Seven out of ten vehicles had a first-test particulate emission level lower than a predetermined cutoff point of 0.35 g/mi. (The California PM certification standard for 1985 light-duty diesel vehicles is 0.4 g/mi.) Attempts were made to regenerate the particulate-trap oxidizers on the three vehicles that exceeded the 0.35 g/mi PM level and the vehicles were retested. Two of three retested vehicles passed the PM cutoff level.

30520 **(PB—88-179353/XAB) Analysis of motor-vehicle fuel-tank-related fires. Technical report.** Steilen, K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Feb 1988. 26p. (EPA/AA/SDSB—88/05). NTIS, PC A03/MF A01.

This report analyzes the motor-vehicle fire data from motor-vehicle fuel tanks and to estimate the current risk of fuel-tank-related fires. The report begins with a summary of currently available data on the annual number of total motor-vehicle fires, post-collision fires, and fuel tank-related fires and the subsequent associated fatalities, injuries and property damage with these fires. A discussion of how the data were analyzed and adjusted to project the number of fuel-tank fires, fatalities, injuries, and property damage in 1990 and beyond when refueling controls could be required is also included.

30521 **(PB—88-180526/XAB) Diesel-fuel quality effects on emissions, durability, and performance. Draft report (Final).** Miller, C.; Weaver, C.; Johnson, W. (Energy and Resource Consultants, Inc., Boulder, CO (USA)). 1987. 135p. NTIS, PC A07/MF A01.

Diesel engines in light and heavy-duty vehicles emit significant amounts of oxides of nitrogen (NOx), particulate matter, sulfur oxides, and unburned hydrocarbons. Emissions levels for these pollutants are strongly affected by the quality and composition of the diesel-fuel used. The study briefly reviews the available data and examines the feasibility, costs, and cost-effectiveness of reducing diesel emissions by mandatory changes in diesel-fuel composition. Two types of changes are considered: (1) a drastic reduction in

diesel fuel sulfur content, alone or in combination with a moderate reduction in the fraction of aromatic hydrocarbons in the fuel, and (2) effects on engine durability, fuel economy, and refining costs. The work here is intended as a preliminary evaluation of the feasibility and cost-effectiveness of diesel emissions control through fuel modifications.

30522 **(PB—88-180559/XAB) Regulatory impact analysis, oxides of nitrogen pollutant specific study, and summary and analysis of comments.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1985. 311p. NTIS, PC A14/MF A01.

This document summarizes the results of all analyses conducted in support of the final rule for nitrogen oxide emission standards for 1987 and later-model-year light duty trucks and the particulate-emission standards for 1988 and later-model-year light duty trucks and the particulate-emission standards for 1988 and later-model-year heavy-duty diesel engines. (50 FR 10606, March 15, 1985). The report also includes the technological feasibility, economic impact, environmental effects, cost effectiveness of the standards, and the development of data on the impacts of several regulatory alternatives.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 30177, 30514

30523 **(PB—88-179338/XAB) Evaluation of M85-fueled 1987 turbo Buick regals. Technical report.** Blair, D.M. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1987. 17p. (EPA/AA/CTAB—87/07). NTIS, PC A03/MF A01.

This report describes emission testing conducted at the EPA Motor Vehicle Emission Laboratory on two turbocharged Buick Regals which were converted to use M-85 fuel (methanol). These vehicles, converted to use methanol fuel, have the potential to create a consumer interest in methanol-fueled or flexible-fueled vehicles due to the increased performance possible when using methanol fuel in a turbocharged engine.

30524 **(PB—88-179346/XAB) Evaluation of Coloroll methanol dissociator for cold-start-assist application. Technical report.** Piotrowski, G.K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1987. 17p. (EPA/AA/CTAB—87/08). NTIS, PC A03/MF A01.

Light-duty M100 neat methanol-fueled engines are difficult to start and run in cold weather because of the single-boiling-point characteristic of the fuel. Gasoline-fueled engines start with less difficulty under the same conditions partly because of the easily ignitable light ends of the fuel such as butanes, which may be vaporized before the cylinder at relatively low temperatures. Some state-of-the-art methanol engines require the addition of gasoline to the fuel to improve their startability. Other methanol engines utilize separate cold-start assist. Some researchers have suggested that a combination of mechanical approaches may produce reliable cold starts of a neat methanol-fueled engine at relatively low ambient conditions. The project evaluates a methanol dissociator supplied by Coloroll, plc, for use as a cold start assist to a methanol engine. The dissociator operation, supporting equipment, program design, test results and conclusions are discussed.

30525 **(PB—88-179361/XAB) Evaluation of Toyota LCS-M Carina. Phase 2. Technical report.** Piotrowski, G.K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1987. 46p. (EPA/AA/CTAB—87/09). NTIS, PC A03/MF A01.

This report describes the results from a number of short programs designed to further define the capabilities of the methanol lean-burn system with regard to pollutant emissions and fuel economy. Testing was conducted using M100 neat methanol exclusively and focused on the effects of: (1) an improved version of the M100 best driveability calibration; (2) the use of a two-catalyst system; (3) increased inertia weight; (4) use of higher-aspect-ratio tires; (5) cold temperatures. Baseline testing and an air/fuel ratio analysis were performed.

30526 **(PB—88-187323/XAB) Direct gas injection with glow-plug ignition. Final report, August 1986-July 1987.** Richards, B.G. (Caterpillar, Inc., Peoria, IL (USA)). Aug 1987. 49p. NTIS, PC A03/MF A01.

Color illustrations reproduced in black and white.

The objective of this work was to show that direct natural gas injection with glow-plug-ignition assist offers potential for allowing natural gas engines to increase specific power output and thermal efficiency to levels comparable to diesel engines. These potential improvements result from changing the current homogeneous-charge, carburetted Otto-cycle gas engines to a direct gas injected diesel cycle. Tests were conducted on a 5.4-inch-bore single cylinder engine utilizing direct natural gas injection with glow-plug ignition assist. The results show that direct natural gas injection with glow-plug ignition assist can provide natural gas engines with specific power output and thermal efficiency (without gas compressor) equal to diesel engines.

35 ARMS CONTROL

3501 Policy, Negotiations, And Legislation

30527 **(LA—11218-MS) Arms control and Soviet grand strategy.** Pilat, J.F. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 13p.

This paper presents therelationship between Soviet approaches to arms control and their security policy and military stragety. Soviet objectives are discussed for the post World War II period, lthe SALT I and II periods, and the most recent period of INF and START proposals.

30528 **(LA—11278) Monitoring space weaponry: Detection and verification issues.** Garrity, P.J.; Gore, R.A.; Pendley, R.E.; Pilat, J.F. (Los Alamos National Lab., NM (USA). Center for National Security Studies). Apr 1988. Contract W-7405-ENG-36. 37p.

If agreements that affect the research, development, testing, or deployment of space weapons are to be reached, the United States must be able to monitor the treaty-limited systems and verify compliance with the agreement. This report attempts to establish guidelines for future space monitoring technologies by briefly examining key types of potential arms control constraints on space weapons; considering the impact of those contraints on current and potential US military capabilities, including the consequences of treaty violations; defining generic monitoring/verification requirements and difficulties for these arms control regimes; and deriving future verification and intelligence collection requirements and technology challenges.

30529 **(UCRL—98234) Radioactive fallout projections and arms control agreements: INF [Intermediate-range Nuclear Forces] and START [Strategic Arms Reduction Treaty].** Shapiro, C.S. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 12p. (CONF-880367—1).

From SCOPE-ENUWAR workshop on the environmental consequences of nuclear war; Moscow, USSR (20 Mar 1988).

Projections of levels of radioactive fallout from a nuclear war are sensitive to assumptions about the structure of the nuclear stockpiles as well as the assumed scenarios for a nuclear war. Recent arms control proposals would change these parameters. This paper examines the implications of the proposed (Intermediate-range Nuclear Forces) INF treaty and (Strategic Arms Reduction Treaty) START on fallout projections from a major nuclear war. We conclude that the INF reductions are likely to have negligible effects on estimates of global and local fallout, whereas the START reductions could result in reductions in estimates of local fallout that range from significant to dramatic, depending upon the nature of the reduced strategic forces. Should a major war occur, projections of total fatalities from direct effects of blast, thermal radiation, a nd fallout, and the phenomenon known as nuclear winter, would not be significantly affected by INF and START initiatives as now drafted. 14 refs.

3503 Verification

REFER ALSO TO CITATION(S) 30528, 31013, 31014

36 MATERIALS

30530 (CONF-880607—2) Advanced Research and Technology Development Fossil Energy Materials Program. Judkins, R.R.; Bradley, R.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p.

From 33. international gas turbine conference and exhibit; Amsterdam, Netherlands (5 Jun 1988).

The Advanced Research and Technology Development (AR and TD) Fossil Energy Materials Programs is a multifaceted materials research and development program. Technical activities on the program are divided into three research thrust areas: structural ceramic composites, alloy development and mechanical properties, and corrosion and erosion of alloys. In addition, assessments and technology transfer are included in a fourth thrust area. This paper provides information on the structure of the program and summarizes some of the major research activities. 6 figs., 2 tabs.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 29903, 29990, 30094, 30099, 30099, 30231, 30236, 30254, 30259, 30368, 30369, 30766, 30820, 30858, 30888, 31721, 31725, 31729, 31735, 31746, 31771, 31920

30531 (AD-A—189255/3/XAB) Relationship of the chemical-bonding topology of high-critical-temperature copper oxide superconductors to that of the Chevrel phases and the ternary lanthanide rhodium borides. Technical report. King, R.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 11 Dec 1987. 9p. (TR—56). NTIS, PC A02/MF A01.

The high-critical-temperature copper oxide superconductors exhibit chemical bonding topologies closely related to those of the ternary molybdenum chalcogenides and ternary lanthanide rhodium borides in which the conducting skeleton is constructed from metal-oxygen-metal rather than direct metal-metal bonds and antiferromagnetic metal-metal interactions occur rather than direct metal-metal bonding.

30532 (AD-A—189385/8/XAB) Fundamental understanding of the effect of alloying elements on the corrosion resistance of rapidly solidified Mg alloys. Annual report No. 2, 1 November 1986-31 October 1987. Kruger, J.; Long, G.G.; Tanaka, D.K.; Joshi, A.; Makar, G.L. (Johns Hopkins Univ., Baltimore, MD (USA)). 16 Nov 1987. 74p. NTIS, PC A04/MF A01.

During the second year of this project, progress was made in the following areas concerned with the effect of alloying elements on the corrosion resistance of RSP Mg alloys: (1) development of the surface-reflection x-ray spectroscopic technique (ref1EXAFS) to carry out structural studies on the films on Mg alloys that control corrosion was completed and applied in measurements at the oxygen K-edge of surface films on high-purity Mg and AZ61 Mg alloys. The existence of magnesium hydroxide on these surfaces was found. (2) Electrochemical studies of the effect of A1, Zn, Ce, Nd, Y, Mn, Li, and Ca in melt-spun Mg alloy ribbons on corrosion behavior were carried out. The corrosion rate decreased with increased percentage of A1 and small additions of Zn. It was found that rapid solidification improves the resistance of the alloy studied (AZ61) to localized Cl^- attack. (3) Surface analytical studies found that only Li and Ca in the RSP Mg alloys have a tendency to be enriched in the films on these alloys. Hydroxides and carbonates were also found in the surface films along with oxides.

30533 (AD-A—189633/1/XAB) Study of the equation of state for copper. Master's thesis. Court, C.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 74p. (AFIT/GEP/ENP—87D-4). NTIS, PC A04/MF A01.

The equation of state of copper was studied by using computer simulations. An existing molecular dynamics program written for the Cray was modified to run on both the VAX and on a parallel-processing system. The program applied the embedded-atom method to determine interatomic forces. Experiments on the VAX found the copper melting point to be very near 1350 K which is close to the known melting point of 1357.6 K. Measurements taken on both types of computers showed that parallel processing offers a time savings factor of 3.75 over serial-processing systems.

30534 (AERE-R—12965) Kinetics of pitting corrosion of carbon steel. Progress report to June 1987. Marsh, G.P.; Taylor, K.J.; Sooi, Z. (UKAEA Harwell Lab. Materials Development Div.). Feb 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753089/JAW.

The development of an improved statistical method for analysing pit growth data to take account of the difference in area of laboratory specimens and full sized high level nuclear waste containers is described. Statistical analysis of data from pit growth experiments with large area (460 cm^2) plates of BS 4360 steel have indicated that the depth distributions correlate most closely with a limited distribution function. This correlation implies that previous statistical analyses to estimate the maximum pit depths in full size containers, which were made using unlimited distribution functions, will be pessimistic. An evaluation of the maximum feasible pitting period based on estimating the period during which the oxygen diffusion flux is sufficient to stabilise a passive film on carbon steel containers has indicated that this is of the order of 125 years rather than the full 1000 year container life. The estimate is sensitive to the value of the leakage current assumed to flow through the passive film, and therefore work is planned to measure this accurately in relevant granitic environments.

30535 (BNL—40469) Polyacrylic acid electrolyte-modified zinc phosphate conversion coatings for corrosion protection of steel. Sugama, T.; Kukacka, L.E.; Carciello, N. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 11p. (CONF-880604—1).

From Joint meeting of the 195th national meeting of the American Chemical Society and the 3rd Chemical Congress of North America; Toronto, Canada (5 Jun 1988).

The present studies are to explore the effects of polyacrylic acid [p(AA)] polyelectrolyte macromolecules when they are internally diffused throughout the crystalline Zn{center←dot}Ph layer, on the improvement in corrosion protection afforded to steel by the Zn{center←dot}Ph, and on the degree of the alkaline dissolution of coatings. Cathodic delamination studies for polyester-modifed polyurethane (PU)-coated Zn{center←dot}Ph specimens were also performed to determine the role of the intermolecular chemical reaction at PU-modified Zn{center←dot}Ph interfaces in reducing the delamination rates of the PU topcoat from the Zn{center←dot}Ph. 8 refs., 2 figs., 1 tab.

30536 (BNL—41065) Optical constants for 22 thin film materials in the 10 eV to 500 eV photon energy region. Windt, D.L.; Cash, W.; Scott, M.; Arendt, P.; Newnam, B.; Fisher, R.F.; Swartzlander, A.B.; Takacs, P.Z.; Pinnco, J.M.; Kortright, J.B. (Lockheed Palo Alto Research Labs., CA (USA); Colorado Univ., Boulder (USA); Los Alamos National Lab., NM (USA); Solar Energy Research Inst., Golden, CO (USA); Brookhaven National Lab., Upton, NY (USA); Crystallume, Inc., Palo Alto, CA (USA); Lawrence Berkeley Lab., CA (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-8708110—35).

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

Reflectance measurements were used to derive the optical constants of 22 materials for 36 photon wavelengths from 24 {Angstrom} to 1216 {Angstrom}. The samples studied are thin films of the transition metals Ti, Zr, Nb, Mo, Ru, Rh, Pd, Hf, Ta, W, Re, Os, Ir, and Pt, the noble metals Ag and Au, and films of C, diamond, Al, Si, CVD-SiC and a-SiC. We describe the experiment and also the data reduction technique used to derive the optical constants from the reflectance versus incidence angle data. A summary of the results is presented. 4 figs., 12 refs.

30537 (CEGB-TPRD/B—1003/R87) Characterisation of AGR fuel cladding alloy using secondary ion mass spectrometry. Allen, G.C.; Sparry, R.P.; Wild, R.K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753606/JAW.

Uranium dioxide fuel used in the Advanced Gas Cooled Reactor (AGR) is contained in a ribbed can of 20wt%Cr/25wt%Ni/Nb stabilised steel. Laboratory circumstances, spall during thermal cycling. To date it has been difficult to identify active material originating from the oxidation product of the cladding alloy in the cooling circuit. In an attempt to solve this problem we have set out to characterise fully a sample of oxide from this source and work is in progress to obtain suitable oxide samples from the surface of a 20%Cr/25%Ni/Nb stainless steel. In view of its high sensitivity and the ability to obtain chemical information from relatively small areas we have sought to use Secondary Ion Mass Spectroscopy (SIMS).

30538 (CONF-880408—1) Amorphous interface between crystalline nickel and titanium films. Walker, F.J.; McKee, R.A.; List, F.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p. (CONF-880408—).

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Using in situ reflection high energy electron diffraction and x-ray diffraction, the structure and composition of nickel and titanium multilayer films have been studied. The films were evaporated under uhv conditions at rates of .01 to .1 nm/sec. When deposited on an amorphous NiTi film at 70{degree}C, the individual layers of nickel or titanium are polycrystalline and textured with the close-packed planes perpendicular to the growth direction. The interface between the layers is amorphous and about 2 nm thick. X-ray scattering from the crystalline layers indirectly shows the composition of the amorphous interface to be Ni rich. 7 refs., 3 figs.

30539 (DOE/CE/15259—T1) Bipolar electrode for Hall-Heroult electrolysis: Final report. Gee, J.T. (Great Lakes Research, Elizabethton, TN (USA)). Jan 1988. Contract FG01-86CE15259. 83p.

Recent progress in the development of inert anodes and wettable cathodes for use in the Hall-Heroult process has prompted studies in bipolar technology as a further means to reduce the production cost of aluminum. The objective of this project was to demonstrate the feasiblity of fabricating a stable monolithic bipolar electrode assembly through the proper choice of materials. Limited research, prior to the this program, led to the development of a bipolar electrode assembly comprising a cermet-based inert anode which is brazed to a TiB_2 cathode element through the use of an intermediate layer. The major task of this research was to identify and incorporate diffusion barriers to limit the diffusion of the end member constituents. Annealing studies were to be carried out to determine the long-term stability and functionality of the electrode as limited diffusionoccurs.

30540 (DOE/ER/10963—4) A comparison of carbide fracture during fixed depth and fixed load scratch tests. Prasad, S.V.; Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). 1985. Contract AC02-81ER10963. 8p. (CONF-850415—8).

From 4. international conference on wear of materials; Vancouver, Canada (14 Apr 1985).

In order to simulate abrasion of dual-phase materials containing large carbides under fixed depth conditions an apparatus has been designed and used to perform scratch tests at a fixed depth of cut on such materials. The scratch test consists of two support arms tipped with small steel balls held in contact with surface by ^{700} g, while the scratch tool is mounted on the tip of a central arm whose adjustable length allow control of the depth of cut. The scratch tool does not deflect significant when it encounters a large carbide. Scratch tests with the new apparatus have been performed on Co-base Stellite alloys containing large Cr-rich carbides, using individual particles of alumina as scratch tools to generate fixed depth scratches. A in situ SEM scratch test apparatus has also been used to genrate fixed load scratches. Comparison of the scratches shows that for comparable average scratch depths, under fixed load conditions the scratch tool deflects over the carbides without causing fracture, but that since it cannot deflect under fixed depth conditions it induces gross carbide fracture. Results suggest that the fixed depth scratch test can be successfully employed to simulate fixed depth abrasion, which has been previously shown to generate gross carbide fracture in these alloys. The in situ SEM scratch test simulates fixed load abrasion conditions such as those which occur in rubber wheel abrasion tests. 12 refs., 9 figs.

30541 (DOE/ER/10963—7) Effects of material and test variables on abrasion. Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Materials Science and Engineering). 1986. Contract AC02-81ER10963. 14p. (CONF-860104—3).

From 3. Berkeley conference on elevated temperature corrosion-erosion-wear of materials; Berkeley, CA, USA (27 Jan 1986).

The general problem of abrasion of metals is reviewed. While a complete separation of material and test variables is impossible in any tribological system, such a separation is adopted for the purpose of discussion, with the interaction between material and test variables being described where appropriate. The essential findings of some unpublished studies by the author and coworkers are included. 54 refs., 4 figs.

30542 (DOE/ER/13744—T1) [Theory of the dissociation dynamics of small molecules on metal surfaces: Finite temperature studies: Progress report]. Jackson, B.E. (Massachusetts Univ., Amherst (USA). Dept. of Chemistry). 1988. Contract FG02-87ER13744. 3p.

Progress is reported on three approaches: quantum mechanics of dissociative adsorption of H_2 on metals: same at finite surface temperatures; and multi-dimensional models for dissociative adsorption. (DLC)

30543 (DOE/NASA/16310—5) Creep behavior of tungsten/niobium and tungsten/niobium-1 percent zirconium composites. Petrasek, D.W.; Titran, R.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1988. Contract AI03-86SF16310. 25p. (NASA-TM—100804; CONF-880122—15; CONF-880122—).

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

The creep behaivor and microstructural stability of tungsten fiber-reinforced niobium and niobium-1% zirconium was determined at 1400 and 1500{degree}K in order to assess the potential of this material for use in advanced space power systems. The creep behavior of the composite materials could be described a power law creep equation. A linear realtionship was found to exist between the minimum creep rate of the composite and the inverse of the composite creep ruture life. The composite mateirals had an order of magnitude increase in stress to achieve 1 percent creep strain and in rupture strength at test temperatures of 1400 and 1500{degree}K compared to unreinforced material. The composite materials were also stronger than the unreinforced materials by an order of magnitude when density was taken into consideration. Results indicate significant potential improvement in high temperature properties and mass reduction for space power system components. 12 refs., 1 2 figs., 2 tabs.

30544 (DP-MS—88-27) Mechanical testing and microscopic analysis of structure of extruded powder aluminum. Woods, T.O.; Berghaus, D.G.; Peacock, H.B. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering; Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 5p. (CONF-880691—1). NTIS, PC A; 02; GPO Dep. Order Number DE88007193/JAW.

From 6. international congress on experimental mechanics; Portland, OR, USA (5 Jun 1988).

The mechanical properties and structure of extruded powder aluminum were studied so that failure mechanisms could be determined. Extruded powder aluminum specimens were mechanically tested at elevated temperature in tension and compression and were then sectioned, polished, and viewed microscopically to examine changes in the powder metal. Quantitative metallography was used to show changes produced in the laminar powder structure. The void content of the material increased with greater axial elongation

in the tension tests and decreased with increasing levels of compression. 6 refs., 6 figs.

30545 **(FhG-W—6/87) Investigations of the behaviour of fast growing cracks using numerical simulation calculations.** Windisch, M. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Mar 1987. 119p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753538/JAW.

The behaviour of the SEN sample (flat tensile sample notched on one side) made of Araldite B resin during crack growth was simulated numerically using the finite difference process. In order to obtain the solution for the static initial state of the system after applying the load and before the crack starts, the system set into movement by applying the load was braked until it was in equilibrium. With the equilibrium condition as the initial condition and from the experimentally determined crack growth curves of twelve experiments, a relationship between the speed of fracture and the stress factor was determined with the simulation program, which agreed with the results of the shadow optics evaluation. (orig./HP) With 23 refs., 60 figs..

30546 **(FMPC—2118) Abrasive waterjet cutting of high purity uranium metal: Topical report.** Dravland, D.J. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). Jan 1988. Contract AC05-86OR21600. 43p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006939/JAW.

The Abrasive Waterjet Cutting process was evaluated to determine if the equivalent could be utilized for cutting uranium metal at the Feed Materials Production Center (FMPC). In the process, a thin stream of ultrahigh pressure water carried grit material through a designated piecepart. In order to be acceptable for use at the FMPC, the equipment must be cost effective, minimize waste, and be adaptableto operating in an enclosure, and improve health and safety conditions. Observation of the cutting process showed that health and safety aspects could be optimized with an enclosed ventilated system. Also the equipment can be easily automated. The cutting action produced sparks similar to the sparks caused by a grinding operation. The sparks are captured in a water container under the workpiece that not only catches the sparks, but also serves to dissipiate the stream of water and residues produced by the cut. Metallographic tests performed on the cut surface of the block of depleted uranium showed no contamination of the uranium metal and the surface finish. 2 figs.

30547 **(FRADOC—15-6) Critical size of defaults inducing fast fracture of deposit stellite on a valve gate.** Boneh, B.; Gilles, P.; Champomier, F.; Abisror, A. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Oct 1986. 23p. (In French). (CONF-8610406—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753069/JAW.

From 5. day's study on pressure vessels; Paris, France (22 Oct 1986).

The present study has been made to determine if, in the case of a valve gate, transversal cracks are the result of fatigue propagation or the result of fast fracture. The author shows that only a transversal crack, with a size up to 0.7 mm, induces a fast fracture and shows also that, at equal size, a crack located under the stellite is not also injurious than a transversal crack.

30548 **(IC—87/268) Model for bimetallic interfaces (II).** Nafari, N.; Das, M.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702672/JAW.

In part (I) we developed a theoretical model for bimetallic interfaces. By using various local and nonlocal density functional formalism, we have calculated the interfacial energies due to a pair of semi-infinite jellia in contact. The nonlocal density functional approximations show greater charge rearrangement in the interfacial region and thereby greater effect on the adhesion energy. We have also calculated the Pauli-Hellman-Feynman forces exerted on each of the jellia and have checked the numerical results of our local and nonlocal calculations with the force sum rule. The sum rule is approximately satisfied by the results for Li-Na, K-Cs, Rb-Cs and K-Rb interfaces. (author). 30 refs, 4 figs, 2 tabs.

30549 **(IC—87/279) Temperature independent time exponent factor in copper recrystallization process.** Nassar, A.M.; Taha, A.S.; Ragab, K.A.; El-Mossalamy, S.M. (International Centre for Theoretical Physics, Trieste (Italy); Atomic Energy Establishment, Cairo (Egypt). Metallurgical Dept.; Ain Shams Univ., Cairo (Egypt). Faculty of Science; Al-Azhar Univ., Cairo (Egypt). Faculty of Science). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702683/JAW.

Isochronal annealing was followed by the two adopted methods, microhardness, and metallographic observation for studying the kinetics of recrystallization in pure copper. From these it was found that nucleation of pure copper started at 300 deg. C. The changes in microhardness during the isothermal annealing were measured at temperatures of 250, 300 and 350 deg. C. For these temperatures, the complete recrystallization as being determined from the metallographic observation, was found to be achieved after times of 5.1 and 0.5 hours. The kinetics of the recrystallization process of this material was studied using an equation of the form x=1-exp(-Kt/sup n/) where (x) is the fraction of the process completed at a given time t, K is the rate constant, and (n) is a constant, characteristic for such processes. The time exponent (n) was found to be the same for all chosen temperatures, i.e., it seems to be temperature independent constant. On the other hand, the recrystallization rate constant (K) was found to be a temperature dependent one, where it increased as the temperature increased, and having the values of $4x10^{-5}$, $2x10^{-4}$ and $7.5x10^{-4}$ for the temperatures 250, 300 and 350 deg. C respectively. The corresponding activation energy for the recrystallization process was calculated, using the Avrami equation and it was found to be (1.47 e.v.). (author). 14 refs, 6 figs.

30550 **(IC—87/322) Mean-field hopping solution in the Anderson-Hubbard model.** Allub, R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702715/JAW.

The tight-binding diagonally disordered Anderson model with on-site Coulomb interaction is solved in the mean-field hopping approach. Phase diagrams of metal-insulator transition are obtained from the free energy for the half-filled band and the binary-alloy distributions. For attractive interaction ($U < 0$), the Coulomb term gives additional localizing effect and for some values of the microscopic parameters the temperature induced two transitions (insulator to metal to insulator). For $U > 0$ two different behaviours are distinguished. For small disorder ($W <= U/2$), the metallic phase can be induced by disorder, while for large W, the disorder always destroys the phase of extended states. (author). 21 refs, 3 figs.

30551 **(INIS-BR—1016) Hydrogen permeation through metallic foils.** Bernardi, M.I.B.; Rodrigues, J.A. (Sao Carlos Univ. (Brazil). Dept. de Engenharia de Materiais). 1987. 5p. (In Portuguese). (CONF-8609421—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702600/JAW.

From Meeting about gases in metals and alloys; Sao Carlos, Brazil (24 Sep 1986).

The process of electrolytic permeation of hydrogen through metallic foils is studied. A double electrolytic cell, in glass, in which the two compartments of reaction are separated by a metallic foil to be studied, was built. As direct result, the hydrogen diffusion coefficient in the metal is obtained. The hydrogen diffusion coefficients in the palladium and, in austenitic stainless steels 304 and 304 L, used in the Angra-1 reactor, were obtained. Samples of stainless steels with and without welding, were used.

30552 (INIS-mf—11186) Theoretical model of the influence of chlorine ion adsorption and the double electrial layer on the metal properties. Zagorski, G.; Gorbatykh, V.P. (Energoproekt, Sofia (Bulgaria)). 1984. 7p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702365/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A model is proposed to describe the changes in metal properties in H_2O with Cl^- environment. It is based on the hypothesis that the adsoption of Cl^- and the variations in the double electrical layer parameters generate electron density waves. This is explained as a effect of overlaping of the Fermi Spheres of I and II metal lattices, and of the microscale variation of the layer parameters in accordance with the uncertainty relations of Heisenberg. Thw propagating electron wave is effectively scattered on the lattice defects of discolation type. The local temperature around dislocations increases leading to an increase in the effective temperature of thermal activation of dislocation motion and formation. This can be taken into account by introducing an effective temperature T/sub e/ff = T +δT/sub e/nv in the Jurkov equation of creep in air, and then estimating the effect of water environment on steel aging.

30553 (INIS-mf—11187) Experimental validation of the theoretical model for media influence on the metal properties and estimation of the life-time of nuclear power plant heat exchanger tubles. Zagorski, G.V.; Gorbatykh, V.P. (Energoproekt, Sofia (Bulgaria)). 1984. 8p. (In Russian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702366/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

The influence of H_2O and $MgCl_2$ environment of the microhardness of austenitic steel 08X18HIOT used in NPP heat exchangers is invistigated experimentally. The measurements are used to test the hypothesis that the adsorption of Cl^- on the metal surface in the presence of water changes the characteristics of the double electrical layer, which in turn degrades the mechenucal properties of the metal by generating electron density or acoustic waves in the suface layer at the interface. Good agreement is observed between the theoretical results and the experimental data, including also data from the literature. A conclusion is made that the model can be used to assess changes in the rate of aging of heat exchanger tubes due to substructure changes under the influence of the environment, with normal or abnormal concentration of chlorine ions.

30554 (IS-T—1316) Nondestructive evaluation methods for determination of thermal history and mechanical properties of aluminum-lithium alloys. Bracci, D.J. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 107p.

A binary A1-8 at{percent} Li and a dommercial Al 2090 alloy have been quenched from the solid solution phase at two different quench rates. Subsequent artificial aging treatments between 150 and 275{degree}C, with aging times ranging from 3 to 33 hours, were chosen to arrive at alloys of different microstructures and mechanical properties. Nondestructive measurements of eddy current impedance change, dc conductivity, microhardness, ultrasonic attenuation, and ultrasonic velocity have been performed. Eddy vary by roughly 5 to 10{percent}. Hardness changes are about two-fold for Al 2090 and about three-fold for the binary alloy. Ultrasonic attenuation and velocity are basically independent of heat treatment. Yield stresses changed by a factor of 4 to 5 and the fracture toughness estimates changed by about 60{percent} for the binary alloy. Yield stress for the Al 2090 changed by about a factor of 3.5. Correlations have been made between the results obtained from the nondestructive measurements and the mechanical properties of the materials. Eddy current impedance change is linearly proportional to hardness except for the Al 2090 alloy aged for 12 hours and longer. Hardness is a strong indicator of yield stress due to their linear relationship. For the binary alloy, there is an asymptotic relationship between hardness and fracture toughness estimates. (38 refs., 58 figs.)

30555 (IS-T—1338) Ultrasonic characterization of metallic interfaces. Palmer, D.D. Jr. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 95p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88007351/JAW.

A set of diffusion bonded copper samples was prepared at different temperatures and times, allowing the bonding to proceed across the planar interfaces. To obtain a second set, interfaces were roughened to various degrees followed by diffusion bonding at a designated time/temperature condition. On all samples, ultrasonic reflection coefficient (R) maps of the bonded interfaces were obtained over a broad frequency range. In addition, the bond strengths, Σ, of the interfaces were determined, thus providing an empirical Σ-R correlation. Nearly all of the specimens tested failed along the interfaces, exposing fracture planes with distinctive features indicating originally bonded and unbonded areas. These features, examined metallographically, allowed for the successful testing of the "distributed spring model" by Baik and Thompson (J. NDE 4, 177, 1984). This model was used as an intermediate step in the development of a bond strength model to explain the observed Σ-R correlation, the beginnings of which are discussed. 32 refs., 22 figs.

30556 (Juel—2127) Experiments on the creep behaviour of semi-finished X10NiCrAlTi 32 20 (Nicrofer 32 20) tubes under multiaxial loading. Franzke, K.; Penkalla, H.J.; Roedig, M.; Schubert, F.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.)). May 1987. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753569/JAW.

Dissertation submitted by K. Franzke.

A basis for the construction of power plant components is the transferability of materials data from standard samples to the semi-finished materials used for the installations. To test this transferability in the creep region for temperatures above 800°C, multiaxial creep tests were performed using tubes in a semi-finished state. The results were compared with the results of uniaxial creep tests using standard samples. Ar 950°C microstructural changes occurred in the tested material (X10NiCrAlTi 32 20, Nicrofer 32 20) which resulted in a creep behaviour which could not be described directly by Nortons's creep equation. There were significant differences in the creep behaviour of the various product forms tested; the tubes showing significant creep hardening in the primary creep range and a delayed onset of the secondary creep range compared with bar material. These differences were caused by cold work introduced during straightening of the semi-finished materials. In spite of these differences in the creep behaviour, the transferability of the materials data is possible, if a conservative method (reference stress of Treska, calculated from the highest stresses in the semi-finished material) of stress calculation is used.

30557 (Juel-Spez—406) Neutron irradiation embrittlement of reactor pressure vessel steel 20 MnMoNi55 weld. Ghoneim, M.M. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Brennelement- und Bestrahlungstechnologie). May 1987. 213p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88753574/JAW.

The effect of neutron irradiation on the mechanical and fracture properties of an 'improved' 20 MnMoNi 55 Pressure Vessel Steel (PVS) weld was investigated. In addition to very low residual element content, especially Cu (0.035 wt.%), and relatively higher Ni content (0.9 wt.%), this steel has higher strength (30% more) than the steels used currently in nuclear reactor pressure vessels. The material was irradiated to $3.5x10^{19}$ and $7x10^{19}$ ncm^2 ($E > 1$ Mev) at 290°C and $2.5x10^{19}$ ncm^2 ($E > 1$ MeV) at 160°C in FRJ-1 and FRJ-2 research reactors at KFA, Juelich, F.R.G. Test methods used in the evaluation included instrumented impact testing of standard and precracked Charpy specimens, tensile, and fracture toughness testing. Instrumented impact testing provided load and energy vs. time (deflection) data in addition to energy absorption data. The results indicated that the investigated high strength improved steel is more resistant to irradiation induced embrittlement than conventional PVSs. (orig.IHOE).

30558 (LA-UR—88-604) Influence of strain rate on the substructure evolution and yield behavior of Ti-6Al-4V. Gray, G.T. III; Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880681—2).

From 6. world conference on titanium; Cannes, France (6 Jun 1988).

Based upon a study of the influence of strain rate on the substructure evolution and mechanical response of Ti-Al6-4V the following conclusions can be drawn: 1) The deformation substructure of Ti-6-4 is observed to depend on both temperature and strain rate. Deformation at quasi-static strain rates at 293K is characterized by planar slip bands in the alpha grains while the deformation substructure at high strain rates (e.g., 5000 s/sup {minus/1}) and at quasi-static rates at 77K consists of numerous deformation twins, {l←brace}1121{r←brace} type believed to be related to the starting texture and strain rate effects. 2) The constitutive equations based on the KocksMecking model have been successfully applied to predict the deformation response of Ti-6-4 to loading path changes involving a relatively narrow regime in strain rate and temperature. Changes in slip character or in deformation mechanism (e.g., deformation twinning) have been observed to correlate with changes in the expected flow behavior, although these results are beyond the current modeling procedures outlined in this paper. 11 refs., 6 figs.

30559 (LBL—24626) Exploratory development in the system Al-Sc-X. Sawtell, R.R.; Morris, J.W. Jr. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 19p. (CONF-880126—2).

From TMS-AIME/ASM symposium on high temperature mechanical properties of ordered intermetallics; Phoenix, AZ, USA (25 Jan 1988).

In the search for new structural materials, systems based on the cubic, Al_3X phase show particular promise both as monolithic materials and as dispersions in an Al matrix. One of the most interesting candidates is the Al_3Sc phase which has been observed as a highly stable, coherent precipitate in Al alloys. Al-Sc-X alloys hardened by this phase have been shown to develop unique combinations of properties. This work examines the Al(ss) → Al_3Sc phase transition for the purpose of predicting potential substitutes or replacements for Sc. Theoretical analyses of intermetallic compound formation and precipitation in the Al-Sc-RE (RE = rare earth elements) are described as are the results of experimental evaluations of such systems. These results include descriptions of new Al-Sc-RE alloys with tensile strengths as high as 310MPa (45 ksi); some of the highest levels attained in an Al alloy on a per atom basis. 22 refs., 3 figs.

30560 (N—88-18708) Study of the production of some superconducting and magnetic materials by solidification in the drop tube and drop tower. Semiannual report, June 1985-May 1987. Wu, M.K. (Alabama Univ., Huntsville (USA)). Jan 1987. 30p. (NASA-CR—182494; NAS—1.26:182494). NTIS, PC A03/MF A01.

A systematic study on the relationship between the microstructure and physical properties of several superconducting materials prepared by solidification in low gravity was conducted. Further study of the materials, such as the applications of hydrostatic pressure which is known to be an effective mean to vary the electronic structure of materials, in conjunction with the detailed microstructure analysis of the samples was also performed to better understand the low gravity effects on the enhancement of the electronic properties. Results of the studies on the directionally solidified AlInSn alloys processed in the KC-135 aircraft and immiscible GaBi alloy prepared during free fall in the Marshall Space Flight Center Drop Tower are presented.

30561 (ORNL/TM—10622) An evaluation of some thermodynamic and transport properties of solid and liquid lithium over the temperature range 200 to 1700 K. Williams, R.K.; Coleman, G.L.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 32p.

Experimental data on the effects of temperature on the density, thermal expansion coefficient, specific heat, enthalpy, vapor pressure, compressibility, surface tension, viscosity, electrical resistivity and thermal conductivity of lithium were reviewed. Comparisons of original data with handbook values revealed some cases in which the latter values should probably be revised. Empirical equations describing the recommended property values are included. 51 refs., 12 figs.

30562 (SAND—77-2283C) Laser measurement of particle velocities in vacuum plasma spray deposition. Smith, M.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880576—1).

From 1. plasma-technik symposium; Lucern, Switzerland (18 May 1988).

The velocity of spray particles in vacuum plasma spray deposition affects particle residence time in the plasma, heat transfer from the plasma to the particles, and the kinetic energy upon impact with the target surface. Hence, particle velocity is an important process variable which influences particle melting as well as the density and adhesion of the deposited material. A laser velocimeter system has been used to investigate the effects of variations in process parameters on particle velocities in a vacuum plasma spray system. The results reveal significant relationships between particle velocity and process parameters such as spray particle size, particle mass density, spray chamber pressure, plasma arc power, and electrode geometry. Conversely, over the range of conditions studied, particle velocity was relatively insensitive to changes in plasma gas supply rate, plasma gas composition, and power feed rate. 6 figs.

30563 (UCRL—98000) The variation of torsional ductility of high-purity aluminum with temperature and strain rate. Kassner, M.E.; Oldani, J.J.; Cadwell, K.L. (Lawrence Livermore National Lab., CA (USA)). 25 Jan 1988. Contract W-7405-ENG-48. 11p. (CONF-880564—1).

From 22. Associazione Italiana di Metallurgie Convention; Bologna, Italy (17 May 1988).

The torsional ductility of high-purity aluminum was measured over a wide temperature range (110-610{degree}C and at three strain rates (5.1 {times} 10/sup {minus/4}, 1.3 {times} 10/sup {minus/2}, and 5.1 {times} 10/sup {minus/1} s/sup {minus/1}; several trends were noted that are only partially consistent with earlier work in this area. At each strain rate, the ductility or strain-to-failure first increases with increasing temperature, followed by decreases beyond a "peak ductility" at a "peak temperature." The peak ductility and peak temperature appear to increase with strain rate. It appears that the lower-temperature ductility trends can be explained by increasing dynamic recovery processes that retared cracking and produce increasing ductility, while at higher temperature diffusive pore formation reduces the ductility. 20 refs., 3 figs.

30564 (Y—2393) Calculation of oxidation rates for iron in CO-CO_2. Condon, J.B. (Oak Ridge Y-12 Plant, TN (USA)). Mar 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007313/JAW.

A new method is proposed for calculating the oxidation of iron in the presence of carbon monoxide and carbon dioxide. It is assumed that the oxidation is limited by an internal oxidation step. The calculational method, based on methods previously used to calculate the hydriding of uranium, uses no parameters for the calculation. The known oxygen solubility and diffusivity in iron along with the precipitation rate constants, all of which are obtainable from the literature, are used to make the calculation. The calculation is in good agreement with the rates of oxidation observed, which would seem to validate the method. 13 refs.

30565 Characterization of surface and resonance phonons for the Ni(001)-c(2 x 2) system. Chen, Y.; Wu, Z.Q.; Xu, M.L.; Tong, S.Y.; Ho, K.; Wang, X. (Department of Physics and Laboratory for Surface Studies, University of Wisconsin—Milwaukee, Milwaukee, Wisconsin 53201). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 9978-9984(15 Jun 1988).

We have analyzed the surface modes and antinode adsorbate-induced bulk modes of the Ni(001)-c(2 x 2)S system. We show that these two classes of phonons contribute to large inelastic electron and/or He-atom scattering cross sections. Three gap modes have been identified for the c(2 x 2) overlayer-covered system and these are compared with the S_6 gap mode of the clean substrate. Quantitative multiple scattering theory for electron-energy-loss cross sections is shown to be essential for proper interpretation of the dispersion data of so-called resonance features.

30566 **Linear augmented-Slater-type-orbital method for electronic-structure calculations. V. Spin-orbit splitting in Cu_3Au.** Davenport, J.W.; Watson, R.E.; Weinert, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973-5000). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 9985-9992(15 Jun 1988).

We have used local-density-functional theory to calculate the energy bands, heat of formation, and core-level shift in the classic ordering alloy Cu_3Au. Contrary to expectations we find that the d bands are largely nonoverlapping with the gold region extending from -4 to -7 eV relative to the Fermi level. The copper d levels are concentrated in the range -1 to -4 eV. Addition of spin-orbit splitting strongly mixes the gold states, producing features which are predominantly j = (5/2 and j = (3/2 with the (5/2 level split weakly by the residual crystal-field effects. This agrees with the interpretation of photoemission data by Eberhardt et al. The total energy yields a heat of formation of -0.048 eV/atom compared with the experimental value of -0.07 eV/atom. The Au 4f core-level position was calculated using a total-energy approach. The fully relaxed shift was found to be 0.3 eV (to larger binding energy) compared with the experimental value of 0.48 eV. The absolute value of the core-level binding energy was calculated to be 84.1 eV, compared to 84.40 eV experimentally.

30567 **Adsorption and growth of Sn on Si(100) from synchrotron photoemission studies.** Rich, D.H.; Miller, T.; Samsavar, A.; Lin, H.F.; Chiang, T. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 10221-10228(15 Jun 1988).

Photoemission spectroscopy was used to study the initial growth and interaction of Sn on Si(100). The as-deposited surfaces were annealed at about 550 °C, generating the following coverage-dependent reconstructions: c(4 x 4), (6 x 2), c(8 x 4), and (5 x 1). Changes in the Si 2p core-level line shape were identified as the selective modification of Si surface dimer atoms by the presence of Sn adatoms. A relative measure of the Sn-adatom—Si-substrate interaction is presented by quantification of the average number of Si surface sites modified in the presence of a Sn adatom for various coverages. The Sn 4d core-level spectra revealed two components for Sn coverages below 1 monolayer (ML), indicating the existence of two inequivalent Sn sites, whose relative occupancy is seen to vary with coverage. The Sn 4d core level for the majority sites roughly follows the movement of the Fermi level within the band gap of Si for increasing Sn coverages, while that for the minority sites remains at a constant binding energy relative to the Si valence-band maximum. Implications concerning the structure of the Sn overlayer are discussed. The Sn-induced band bending and the Schottky barrier height are obtained. Photoemission from the valence bands near the Fermi level shows that the Sn-covered Si(100) surface has little density of states at the Fermi level for coverages below 1 ML.

30568 **Frequency-dependent transport properties of UPt_3.** Beyermann, W.P.; Gruener, G.; Dalicheouch, Y.; Maple, M.B. (Department of Physics and Solid State Science Center, University of California, Los Angeles, California 90024). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 10353-10356(15 Jun 1988).

Resistivity [rho(ω)] measurements are reported in the millimeter-wave spectral range over the temperature interval from 1.3 to 300 K in the heavy-fermion compound UPt_3. Below 148 GHz the low-temperature ($T<4$ K) data are in agreement with a Drude expression, with an enhanced relaxation time. The effective mass is derived from rho(ω) and is compared with the thermodynamic effective mass.

30569 **Polar Kerr-effect observation of perpendicular surface anisotropy for ultrathin fcc Fe grown on Cu(100).** Liu, C.; Moog, E.R.; Bader, S.D. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **60**: No. 23, 2422-2425(6 Jun 1988).

The predicted perpendicular surface anisotropy is observed for ferromagnetic fcc Fe/Cu(100) via in situ, polar Kerr-effect measurements. Square hysteresis loops are obtained for films 1.5 to 5.7 monolayers thick for 100-K growth. The region of stability of the perpendicularly magnetized state as a function of growth temperature and film thickness is delineated. Combined longitudinal and polar Kerr-effect measurements show that the anisotropy reverts to being in plane for films thicker than ~6 monolayers.

30570 **Residual strain gradients in a fully stabilized zirconia sample.** Hwang, B.; Houska, C.R.; Ice, G.E.; Habenschuss, A. (Department of Materials Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Journal of Applied Physics;* **63**: No. 11, 5351-5356(1 Jun 1988).

Polished and severely ground fully stabilized zirconia samples are examined using primarily x-ray diffraction (XRD). The XRD (111) profile reflections from both samples were broadened asymmetrically compared to that of an annealed sample. The asymmetry results from a d-spacing gradient extending from the free surface into undisturbed bulk material. There are two possible origins of this depth gradient, i.e., variations in residual strain or chemical composition. The latter is eliminated by means of x-ray photoelectron spectroscopy which did not reveal a chemical gradient. d-spacing profiles for both samples are obtained nondestructively using a trial and error fitting procedure. A maximum compressive strain of ~4% is obtained at the surface of the ground sample which decreases gradually to zero at greater depths. The overall zone is ~1—2 μm. A similar but smaller compressive zone is found in the polished sample which is followed by a zone of tension. The maximum compressive strain at the surface is ~5% and the overall zone of residual strain is ~0.1 μm.

30571 **Fluorescence quantum efficiency and optical heating efficiency in laser crystals and glasses by laser calorimetry.** Ramponi, A.J.; Caird, J.A. (Lawrence Livermore National Laboratory, University of California, P. O. Box 5508, Livermore, California 94550). *Journal of Applied Physics;* **63**: No. 11, 5476-5484(1 Jun 1988). Contract W-7405-ENG-48.

A photocaloric technique is described for determining the fluorescence quantum efficiencies and optical heating efficiencies of optically active ions in laser materials. Optical absorption within the sample results in a temperature increase until the heat produced by the absorbed power is balanced by heat leakage to the surroundings. The fluorescence quantum efficiency and optical heating efficiency are determined from a measure of the absorbed power, the steady-state temperature, and the time constant associated with sample cooling following laser excitation. An alternative analysis utilizing only the absorbed power and the steady-state temperature as a function of excitation frequency is also shown to yield quantum efficiencies consistent with the first method. Theory and experiment are demonstrated by measuring the fluorescence quantum efficiency and optical heating efficiency for trivalent chromium in gadolinium scandium gallium garnet. Measurements are also reported for several neodymium-doped phosphate laser glasses.

30572 **Many-body surface strain and surface reconstructions in fcc transition metals.** Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **60**: No. 22, 2288-2291(30 May 1988).

Bonding in the near-surface region is strongly influenced by the truncation of the lattice at the surface. This many-body effect is examined quantitatively by use of the embedded-atom method on low-index transition-metal surfaces. An unreconstructed metal surface is found to have a tensile strain of several percent. This many-body surface strain is an importnat factor in the energetics of surface structure, serving as a parameter combining surface stress and nonlinear elastic effects. In particular, it is demonstrated that the surface strain drives surface reconstruction, and also produces asymmetry in the stability properties of thin mismatched epitaxial overlayers.

30573 High T/sub c/ superconductornoble-metal contacts with surface resistivities in the 10^{-10} Ω cm² range. Ekin, J.W.; Larson, T.M.; Bergren, N.F.; Nelson, A.J.; Swartzlander, A.B.; Kazmerski, L.L.; Panson, A.J.; Blankenship, B.A. (Electromagnetic Technology Division, National Bureau of Standards, Boulder, Colorado 80303). *Applied Physics Letters;* **52**: No. 21, 1819-1821(23 May 1988).

Contact surface resistivities (product of contact resistance and area) in the 10^{-10} Ω cm² range have been obtained for both silver and gold contacts to high T/sub c/ superconductors. This is a reduction by about eight orders of magnitude from the contact resistivity of indium solder connections. The contact resistivity is low enough to be considered for both on-chip and package interconnect applications. The contacts were formed by sputter depositing either silver or gold at low temperatures (<100 °C) on a clean surface of $Y_1 Ba_2 Cu_3 O_7$√/sub δ/ (YBCO) and later annealing the contacts in oxygen. Annealing temperature characteristics show that for bulk-sintered YBCO samples there is a sharp decrease in contact resistivity after annealing silverYBCO contacts in oxygen for 1 h at temperatures above ~500 °C and goldYBCO contacts for 1 h above ~600 °C. Oxygen annealing for longer times (8 h) did not reduce the contact resistivity of silver contacts as much as annealing for 1 h. Auger microprobe analysis shows that indiumYBCO contacts contain a significant concentration of oxygen in the indium layer adjacent to the YBCO interface. Silver and gold contacts, on the other hand, contain almost no oxygen and have favorable interfacial chemistry with low oxygen affinity. Silver also acts as a "switchable" passivation buffer, allowing oxygen to penetrate to the YBCO interface at elevated temperatures, but protecting the YBCO surface at room temperature.

30574 Role of surface-state nesting in the incommensurate reconstruction of Mo(001). Wang, X.W.; Chan, C.T.; Ho, K.M.; Weber, W. (Ames Laboratory—U.S. Department of Education, Department of Physics, and Microelectronics Research Center, Iowa State University, Ames, Iowa). *Physical Review Letters;* **60**: No. 20, 2066-2069(16 May 1988). Contract W-7405-ENG-82.

First-principles total-energy calculations have been performed for the Mo(001) surface. Subsequent tight-binding calculations of the surface-phonon dispersion curves for the reconstructed surface show that Fermi-surface nesting of surface states leads to a softening of surface modes near M-bar, with the maximum instability very close to the wave vector of the observed incommensurate reconstruction. Our results disagree strongly with the prevailing short-ranged force models for the incommensurate reconstruction on Mo(001).

30575 Inverse of the photoelectric effect in Al. Drube, W.; Himpsel, F.J.; Feibelman, P.J. (IBM Research Division, Thomas J. Watson Research Center, Yorktown Heights, New York 10598). *Physical Review Letters;* **60**: No. 20, 2070-2073(16 May 1988).

Theoretical predictions for inverse photoemission from free-electron-like materials are tested by measurement of the energy and angle dependence of the emitted photon intensity from Al. The predicted cross-section minimum at the plasma frequency ω/sub p/ is observed as well as a characteristic increase below ω/sub p/ due to the inverse of the surface photoelectric effect. Above ω/sub p/ there is an additional bulklike contribution from the radiative decay of bulk plasmons. Other materials with a well-defined plasma resonance, e.g., Ge and Si, exhibit a similar cross-section behavior.

30576 Electronic structure of the icosahedral and other phases of aluminum-manganese alloys studied by soft-x-ray emission spectroscopy. Ederer, D.L.; Schaefer, R.; Tsang, K.; Zhang, C.H.; Callcott, T.A.; Arakawa, E.T. (National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 15, 8594-8597(15 May 1988).

Aluminum L/sub 2,3/ soft-x-ray emission spectra have been observed for several aluminum-manganese alloys exhibiting icosahedral, decagonal, and the normal crystalline symmetries. The spectra of all the alloys are qualitatively similar and are slightly narrower (~0.2 eV) than the width observed for metallic aluminum. Compared to the sample with crystalline symmetry, the quasicrystals show no chemical shift and a decrease in the partial density of states of s and d symmetry at the Fermi energy, contradicting the predictions of several calculations.

30577 Many-body small-cluster theory of bcc Fe, Co, and the Fe-Co alloy. Sowa, E.C.; Falicov, L.M. (Department of Physics, University of California, Berkeley, Berkeley, California 94720 and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 15, 8707-8712(15 May 1988). Contract AC03-76SF00098.

An exact solution for a two-site crystal model, the smallest body-centered-cubic crystal, is presented for cobalt, iron, and the virtual-crystal iron-cobalt alloy. The model consists of five d-like orbitals per site per spin, with interatomic hopping terms and an on-site Coulomb interaction of the fullest generality allowed by atomic symmetry. The ground-state spin polarization per atom is found to begin at 2 for cobalt, rise to 2.5 for the iron-cobalt alloy, and drop back down to 2 for iron. This behavior, which mimics the peak in the Slater-Pauling magnetization curve for this system, is dominated by one-electron properties rather than the Coulomb interaction. The many-body energy-level spectra and intracluster charge and spin fluctuations are also computed.

30578 Calorimetric observations of amorphous and crystalline Ni-Zr alloy formation by solid-state reaction. Cotts, E.J.; Wong, G.C.; Johnson, W.L. (Keck Laboratory, California Institute of Technology, Pasadena, California 91125). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 15, 9049-9052(15 May 1988).

Differential scanning calorimetry and x-ray diffraction are utilized in a study of solid-state vitrification of multilayered composites of Ni and Zr. In order to understand better and optimize the amorphizing reaction, we have examined the kinetics of competing reactions: the formation and growth of crystalline intermetallic compounds. The value of the activation energy, E/sub c/, of the initial crystallization of the growing amorphous phase is determined to be E/sub c/ = 2.0 +- 0.1 eV, establishing an upper limit on the thermal stability of the amorphous-diffusion couple.

30579 Painter and Averill reply. Painter, G.S.; Averill, F.W. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **60**: No. 19, 1982-1982(9 May 1988).

A reply to the comment on bond strain at grain boundaries of Nickel with boron and sulfur as segregants is presented. (AIP)

30580 Inelastic neutron scattering from Sendust. Dobrzyn-acute-accentski, L.; Wis-acute-accentniewski, A.; Uemura, Y.J.; Shapiro, S.M.; Wicksted, J.P. (Faculty of Physics, Warsaw University Branch at Bialystok, 15-424 Byalystok, Lipowa 41, Poland). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7175-7181(1 May 1988).

Inelastic neutron scattering experiments have been performed on a single crystal of Sendust (Fe/sub 2.94/Al/sub 0.38/Si/sub 0.68/) in order to study the spin dynamics below and above the ferromagnetic Curie temperature T/sub C/ = 794 +- 1 K. Below T/sub C/, clear ferromagnetic spin waves are observed up to the energy transfer of about 60 meV. The resulting dispersion relation and line broadenings are compared with theoretical models. Above T/sub C/, paramagnetic scattering is observed with the energy width Γ varying like q/sup 2.5/.

30581 Icosahedral phase formation in rapidly quenched aluminum—ruthenium alloys. Anlage, S.M.; Fultz, B.; Krishnan, K.M. (Applied Physics and Materials Science, California Institute of Technology, Pasadena, California 91125). *Journal of Materials Research;* **3**: No. 3, 421-425(May 1988).

Systematic rapid quenching experiments on the icosahedral phase-forming system Al_1√/sub x/Ru/sub x/ were performed for x<20 at. %. The solidified alloys have been studied by electron microscopy and x-ray diffraction to determine their composition, constituent phases, and phase morphology. It has been determined that the icosahedral phase must form directly from the liquid and, at

these quench rates, is always found in the presence of second or third phases. The results have been summarized in a metastable phase diagram appropriate for rapid solidification of Al$_3$V/sub x/Ru/sub x/ at piston and anvil quench rates. This metastable phase diagram describes the results for Ru concentrations less than 14 at. %.

30582 Coble creep in a powder-metallurgical nickel aluminide of composition Ni—22.8Al—0.6Hf—0.1B (at. %). Schneibel, J.H.; Porter, W.D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* **3**: No. 3, 403-406(May 1988). Contract AC05-84OR21400.

Coble creep, which is controlled by mass transport along grain boundaries, has been identified in a powder-metallurgically prepared nickel aluminide with the nominal composition Ni—22.8Al—0.6Hf—0.1B (at. %). Diffusional creep rates epsilon-dot as a function of temperature T, stress σ, and grain size L are well described by epsilon-dot = 33δ/sub b/D/sub b/$\Omega\sigma$(kTL^3), where δ/sub b/D/sub b/ = 3 x 10^{-6} m^3 s^{-1} x exp[-(313 kJmol)(RT)] (δ/sub b/ is the diffusional grain boundary width, D/sub b/ is the grain boundary diffusivity, R is the gas constant, and T is the absolute temperature). The activation energy of 313 kJmol is unusually high as compared to that for volume diffusion.

30583 Thermal fission-induced crystalline-to-amorphous transformation in U_6Fe. Parkin, D.M.; Elliott, R.O. (Center for Materials Science, University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Materials Research;* **3**: No. 3, 453-460(May 1988).

The crystalline-to-amorphous transformation in U_6Fe produced by thermal fission fragment damage was studied using resistivity and differential scanning calorimetry. The results are described in terms of a model of radiation-produced defect buildup in the crystalline matrix followed by transformation of small regions to an amorphous phase when a critical local defect concentration is reached. This can occur directly in a single cascade or from cascade overlap. The total resistivity is modeled assuming an inhomogeneous media consisting of a crystalline matrix containing a dose-dependent concentration of defects and amorphous zones. The crystallization behavior is initially, starting at T/sub c/ = 388 K, a kinetically limited process of shrinkage of amorphous zones that gradually transforms to nucleation and growth in fully amorphous material at T/sub c/ = 555 K.

30584 Growth, atomic structure, and oxidation of chromium overlayers on W(110). Shinn, N.D.; Berlowitz, P.J. (Sandia National Laboratories, Division 1134, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 597-599(May 1988).

Novel structural and chemical properties of Cr monolayer, bilayer, and multilayer films on W(110) have been identified using temperature programmed desorption, low-energy electron diffraction, and Auger electron spectroscopy. A pseudomorphic (1 x 1) Cr monolayer forms at T>100 K which is stable up to desorption at ~1290 K despite a ~9% lattice mismatch. The second monolayer forms a metastable (2 x 2) structure in the 500 K <T<800 K range, for which a quad-cluster model is proposed. An (11 x 11) coincidence lattice is observed for multilayer films. Oxidation of the Cr overlayers leads to both an interfacial oxide and Cr_2O_3-like phases. Cr_2O_3/W(110) incommensurate epitaxy is observed for thick Cr films.

30585 Domain mixtures in the NiAl(111) surface. Noonan, J.R.; Davis, H.L. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 722-725(May 1988).

The NiAl(111) surface structure has been determined using low-energy electron diffraction (LEED) I—V intensity analysis. From considerations of the stacking sequence of the (111) planes in the bulk, the surface would be expected to be terminated in one of two types of domains, i.e., in a layer of Al atoms or of Ni atoms. The results of the LEED analysis demonstrate that the NiAl(111) has ordered domains of both Al- and Ni-terminated layers. Importantly, the relaxations within the two types of domains are determined to be significantly different as well.

30586 Atomic and molecular states of oxygen chemisorbed on tungsten(112). Wendelken, J.F. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6024). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 662-664(May 1988).

High-resolution electron energy-loss spectroscopy, x-ray photoemission spectroscopy, and low-energy electron diffraction have been used to characterize the adsorption of oxygen on tungsten(112) as a function of temperature and coverage. Two atomic adsorption sites are observed at 300 K, while at 100 K a molecular state is also observed. Coverage-dependent shifts in the vibrational spectra suggest that atoms in the first adsorption site both strongly influence and are strongly influenced by a lateral shift surface reconstruction while atoms adsorbed in the second site have only a limited relation to the reconstruction. Molecular adsorption is blocked by the atoms in the second site, but occurs only after population of the first site.

30587 Percolative aspects of nonequilibrium adlayer structure. Evans, J.W.; Sanders, D.E. (Ames Laboratory and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 726-729(May 1988).

For any adsorption process where all binding sites eventually fill, there exists a coverage θ/sub c/ at which a filled cluster (defined by linking neighboring filled sites) first spans the substrate. Such percolation features have been studied extensively for random distributions of filled sites. Here θ/sub c/ = 0.59 monolayers for "p(1 x 1) ordering" on an infinite square lattice. Cooperative island-forming adsorption involves competition between nucleation, growth, and coalescence or linkage of individual islands. Here clusters of linked islands eventually span the substrate. We use correlated percolation theory to provide a quantitative description of corresponding θ/sub c/ behavior, and of the fractal structure of the clusters of linked islands and their perimeters. Modified grain growth models, which correspond to continuum percolation problems, are also useful here. We show how percolation theoretic ideas can be extended to analyze nonpercolating c(2 x 2) ordering. Even for the essentially random adsorption mechanisms of H_2O on Fe(001), and oxygen on Pd(100), such nonequilibrium c(2 x 2) ordering is significant. We also discuss how island-forming cooperativity here affects the c(2 x 2) ordering.

30588 Quantitative surface electron spectroscopies: Application to the study of corrosion of metals and glasses. Maschhoff, B.L.; Zavadil, K.R.; Nebesny, K.W.; Armstrong, N.R. (Department of Chemistry, University of Arizona, Tucson, Arizona 85721). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 907-913(May 1988).

The surface chemical reactions of extremely reactive metals such as lithium have been explored using x-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES). Corrosion processes which occur at the lithium surface, or corrosion reactions occurring at lithium/glass interfaces, are difficult to characterize by normal ex situ analyses which may damage the interface of interest. Starting with atomically clean surfaces, XPS and AES can be used to help construct a surface with controlled composition passive layers which can then be immersed into electrochemical environments and systematicaly studied. Careful analysis of the XPS or AES data is needed to provide reliable molecular information and quantitation of the actual metal surface regions.

30589 Chemical cleaning of metal surfaces in vacuum systems by exposure to reactive gases. Grunze, M.; Ruppender, H.; Elshazly, O. (Laboratory for Surface Science and Technology and Department of Physics and Astronomy, University of Maine, Orono, Maine 04469). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1266-1275(May 1988).

Chemical surface cleaning procedures for metals using oxidation/reduction cycles by exposure to oxidizing (O_2, NO) and reducing (H_2, NH_3) gases are summarized and an update of the original compilation for chemical cleaning procedures published by Musket et al. [Appl. Surf. Sci. 10, 143 (1982)] is given. Examples discussed in this paper are cleaning procedures for iron, nickel, palladium, copper, and silver surfaces. We also present data on the reduction of gaseous contaminants in a stainless-steel UHV system by flowing nitric oxide through the system during bakeout.

30590 **Surface oxidation of a Pt—20% CO alloy: An x-ray photoelectron spectroscopy and low-energy electron diffraction study on the [100] and [111] oriented single-crystal surfaces.** Bardi, U.; Beard, B.C.; Ross, P.N. (Dipartimento di Chimica, Universita di Firenze, 50121 Firenze, Italy). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 665-670(May 1988).

The interaction of oxygen with the surface of a Pt alloy containing ~20 at. % of cobalt was studied by low-energy electron diffraction (LEED) and x-ray photoelectron spectroscopy (XPS). At this composition, cobalt was found to be randomly substituted in the Pt fcc lattice both in the bulk and at the surface. [111] and 100] oriented single-crystal surfaces as well as polycrystalline surfaces were studied. Dosing these surfaces with oxygen at room temperature at pressures lower than ~1 x 10^{-6} Torr resulted in the formation of a chemisorbed oxygen layer. At temperatures over ~700 K dosing with oxygen in the same range of pressures led to the formation of a sequence of ordered oxide overlayers. XPS and LEED data showed that the first layer to form was an epitaxial monolayer structurally equivalent to either the (111) or (100) plane of cobalt monoxide (CoO). Under conditions of controlled oxygen dosing, CoO islands of monatomic thickness nucleated and randomly decorated a nearly pure Pt surface. This surface-decoration structure was metastable over a narrow range of oxygen partial pressures and surface temperature. At higher temperatures and pressures, the oxide islands first coalesced, forming a compact monolayer that completely blocked the surface for chemisorption, then changed in stoichiometry and structure to form a structural precursor to Co_3O_4.

30591 **Oxidation of amorphous Ni—Nb films: Surface spectroscopy studies.** Christensen, T.M. (Corrosion Division 1841, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 914-917(May 1988).

Sputter deposited amorphous Ni—Nb alloy films have been proposed as thin-film metallization layers for high-temperature (>300 °C) compound semiconductor applications. We have used x-ray photoelectron spectroscopy (XPS) to investigate the oxidation behavior of 1-μm-thick, sputter deposited, amorphous Ni_{60} Nb_{40} films exposed to oxygen or room air at temperatures in the range 30—500 °C for times of 5 min to 45 h. The initial stages of oxidation were examined in situ at oxygen partial pressures below 1 x 10^{-6} Torr. At all temperatures, Nb_2O_5 formed on the surface; this remained the dominant corrosion product for specimens oxidized in air for 45 h at temperatures up to 200 °C. Angle-resolved XPS measurements indicated that a thin (5—10 A) NiO layer formed on the surface of the Nb_2O_5 after long exposures at these temperatures. Specimens oxidized at temperatures above 240 °C, however, quickly developed a thick (>100 A), crystalline NiO layer on top of the Nb_2O_5.

30592 **Adsorption of H_2O on annealed and damaged iron.** Baer, D.R.; Jones, R.H. (Pacific Northwest Laboratory, Richland, Washington 99352). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1090-1093(May 1988).

The tips of advancing cracks are highly strained and may adsorb atoms or molecules from gaseous or liquid environments at rates different from unstrained surfaces. The influence of stress and sputter damage has previously been investigated for H_2S adsorption on iron, and this paper reports the extension of the work to H_2O on iron. Auger electron spectroscopy and x-ray photoelectron spectroscopy examination of water adsorption on polycrystalline and (110) iron show that the saturation coverage of oxygen is not altered by ion beam damage, but that the adsorption rate can be increased by more than a factor of 10. These results are similar to those found for H_2S and have been interpreted in terms of a precursor adsorption model.

30593 **Laser enhanced adhesion of copper films to sapphire substrates.** Pedraza, A.J.; Godbole, M.J.; Kenik, E.A.; Lowndes, D.H.; Thompson J.R. Jr. (Department of Materials Science and Engineering, University of Tennessee, Knoxville, Tennessee 37996-2200). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1763-1767(May 1988).

Strongly adherent films of copper on sapphire can be grown by discrete and sequential sputter depositions alternating with pulsed laser treatment (PLT). In this work the influence of various processing parameters on the film adhesion and morphology are analyzed. Ultraviolet excimer lasers produce less damage to metallic films than do other visible or infrared pulsed lasers. However, the laser energy density must be carefully controlled in order to prevent excessive evaporation or film damage. Film damage and separation from the substrate are likely to occur during PLT if the initial copper films are thicker than 80 nm. Transmission electron microscopy reveals the formation of an intermediate copper/alumina compound in a 30-nm-thick film grown in two steps (10 nm+PLT+20 nm+PLT). The regions of strong copper—sapphire bonding and good thermal contact that are established in the early stages of the sequential deposition process, and that are maintained during the subsequent process of building up a thick, adherent copper film, most probably consist of this intermediate compound.

30594 **Rare-gas impurities in alkali metals: Relation to optical absorption.** Meltzer, D.E.; Pinski, F.J.; Stocks, G.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* 37: No. 11, 6011-6018(15 Apr 1988). Contract AC05-84OR21400.

An investigation of the nature of rare-gas impurity potentials in alkali metals is performed. Results of calculations based on simple models are presented, which suggest the possibility of resonance phenomena. These could lead to widely varying values for the exponents which describe the shape of the optical-absorption spectrum at threshold in the Mahan--Nozieres--de Dominicis theory. Detailed numerical calculations are then performed with the Korringa-Kohn-Rostoker coherent-potential-approximation method. The results of these highly realistic calculations show no evidence for the resonance phenomena, and lead to predictions for the shape of the spectra which are in contradiction to observations. Absorption and emission spectra are calculated for two of the systems studied, and their relation to experimental data is discussed.

30595 **Metals physics at ultrahigh pressure: Aluminum, copper, and lead as prototypes.** Nellis, W.J.; Moriarty, J.A.; Mitchell, A.C.; Ross, M.; Dandrea, R.G.; Ashcroft, N.W.; Holmes, N.C.; Gathers, G.R. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550 and Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853-2501). *Physical Review Letters;* 60: No. 14, 1414-1417(4 Apr 1988). Contract W-7405-ENG-48.

New shock compression data for Al, Cu, and Pb in the pressure range 0.3--1 TPa (3--10 Mbar) have been combined with first-principles theory and earlier equation-of-state data to give the first self-consistent description of the thermodynamic states of metals at ultrahigh pressures. No evidence is found for a break in the slope of the shock Hugoniot of Al near 0.5 TPa, as claimed by Al'tshuler.

30596 **(PB—88-174453/XAB) Multicomponent diffusion coatings.** Lyakhovich, L.S.; Voroshnin, L.G.; Panich, G.G.; Shcherbakov, E.D. (National Bureau of Standards, Washington, DC (USA)). 1987. Translation of mono. Mnogokomponentnye Diffuzionnye Pokrytiya, Minsk, 1974 295p by K. M. Gupt. (TT—79-52019). 303p. NTIS, PC A14/MF A01.

In this book, the processes and results of simultaneous diffusion saturation of steels and alloys containing two or more elements have been examined; in most cases there is a formation of a diffu-

sion layer on the metal surface of essentially higher quality as compared to multicomponent saturation layers. Extensive information is provided in relation to specific processes of simultaneous saturation of steels and alloys containing a wide range of elements such as boron, silicon, chromium, and aluminum as well as in combinations of three elements. Advantages of mathematical modeling of the experiment in the study of thermochemical treatment have been indicated. The book is intended for scientists working on protective coatings on metals. It can also be of use to industrial scientists, graduates and post-graduates working in the field of metal physics.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 29990, 30310, 30536, 30562, 30571, 30573, 30644, 30671, 30678, 30749, 31768, 31784

30597 **(AD-A—189095/3/XAB) Observed trends in the x-ray photoelectron and Auger spectra of high-temperature superconductors. Interim technical report.** Ramaker, D.E.; Turner, N.H.; Murday, J.S.; Toth, E.; Osofsky, M. (George Washington Univ., Washington, DC (USA). Dept. of Chemistry). 1 Oct 1987. 7p. (TR—37). NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 36, No. 10, 5672-5675(1 Oct 1987).

X-ray photoelectron spectra and Auger-electron spectra are reported for $La_2Cu_3O_4$ and $YBa_2Cu_3O_4$ in the tetrahedral and orthorhombic crystal structures; they are compared to previously reported data for Cu, Cu_2O, and CuO. These data reveal large electron-electron interaction effects. The magnitude of these interaction effects correlate with the transition temperatures for the superconducting oxides.

30598 **(AD-A—189137/3/XAB) Compilation of NRL publications on high-temperature superconductivity. Report for 1 January-1 July 1987.** Gubser, D.U. (Naval Research Lab., Washington, DC (USA)). 1987. 250p. NTIS, PC A11/MF A01.

Partial contents include: Superconducting Phase Transitions in the La-M-Cu-O Layered Perovskite System, M = La, Ba Sr, and Pb; Temperature-Dependent X-Ray Studies of the High T/sub c/ Superconductor La(1.9)Ba(0.1)CuO_4; X-Ray Identification of the Superconducting High T/sub c/ Phase in the Y-Ba-Cu-O System; Processing and Properties of the High T/sub c/ Superconducting Oxide Ceramic $YBa_2Cu_3O_7$; Phonon Density of States and Structure of the Superconductor $YBa_2Cu_3O_7$; Magnetic Field Studies of the La(2-x)M$xCuO_4$ and $Ba_2Y1Cu_3O_7$ High T/sub c/ Superconductors; Preparation, Structure, and Magnetic Field Studies of High T/sub c/ Superconductors; Electronic Structure, Bonding and Electron-Phonon Interaction in La-Ba-Cu-O Superconductors; Band Theory Analysis Of Anisotropic Transport in La_2CuO_4-Based Superconductors; Prediction of Anisotrophic Thermopower of La(2-x)M$xCuO_4$; Character of States Near the Fermi Level in $YBa_2Cu_3O_7$; Complex Hamiltonians: Common Features of Mechanisms of High T/sub c/ and Slow Relaxation; Plasma-Sprayed Superconducting-Oxide Coatings; Resonant Photoemission Study of Superconducting Y-Ba-Cu-O; Observed Trends in the X-Ray Photoelectron and Auger Spectra of High-Temperature Superconductors; and Impact of High-Temperature Superconductors on High-Power, Millimeter-Wave Source Technology.

30599 **(AD-A—189524/2/XAB) Nondestructive evaluation of carbon-carbon coatings. Final report, 1 August 1984-23 February 1987.** Copley, D.C.; Rooney, M. (General Electric Co., Cincinnati, OH (USA). Aircraft Engine Business Group). Oct 1987. 94p. NTIS, PC A05/MF A01.

General Electric, with Southern Research Institute as subcontractor, completed this program to investigate differential-adsorption, nondestructive evaluation for carbon-carbon coatings. An optimum fluorescent particle and application method were developed to visualize crack patterns in the coatings. A stress-analysis model was developed to predict crack spacing as a function of coating properties, and this provided excellent agreement with experimental results. A study was made of the potential to improve oxidation life by adding glass formers to the fluorescent particle suspension. A number of methods for measurement of coating thickness were investigated, and eddy-current measurement was found to be the most accurate.

30600 **(BNL—40828) Antiferromagnetism in the high-T/sub c/-related compounds.** Sinha, S.K.; Moncton, D.E.; Johnston, D.C.; Vaknin, D.; Shirane, G.; Stassis, C. (Exxon Research and Engineering Co., Annandale, NJ (USA); Brookhaven National Lab., Upton, NY (USA); Ames Lab., IA (USA)). 1987. Contract AC02-76CH00016. 18p. (CONF-871126—12). NTIS, PC A03;3. Order Number DE88007571/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

Magnetic susceptibility measurements on La_2CuO/sub 4-y/ have revealed maxima in temperature indicative of antiferromagnetic ordering. Powder diffraction measurements have demonstrated the existence of superlattice peaks at temperatures below those corresponding to the susceptibility maxima, and polarized neutron measurements have confirmed that the peaks are indeed of magnetic origin. The deduced antiferromagnetic structure in the orthorhombic (Cmca) phase of La_2CuO/sub 4-y/ consists of ferromagnetic sheets of Cu atoms in the b-c plane which are alternating in sign along the a-axis [100]. The moment is parallel to the c-axis. The Neel temperature is extremely sensitive to the oxygen deficiency y and decreases rapidly t zero as y goes from 0.03 to zero. The saturated moment is ≃0.4 μ/sub B/Cu atom for samples with the highest T/sub N/ (290 K). Antiferromagnetic spin fluctuations have also been observed by polarized neutron scattering in the paramagnetic phase above T/sub N/. Recent results obtained on magnetic ordering in the YBa_2Cu_3O/sub 6-y/ family of compounds are also discussed, together with the possible implications for novel superconductivity mechanisms. 23 refs., 5 figs.

30601 **(BNL—41004) Static and dynamic spin correlations and antisymmetric exchange in La_2CuO_4.** Birgeneau, R.J.; Kastner, M.A.; Aharony, A.; Shirane, G.; Endoh, Y. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 9p. (CONF-880206—7).

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Neutron scattering, susceptibility and magnetoresistance studies provide detailed information about the static and dynamic spin correlations in La_2CuO_4, including the effects of antisymmetric exchange. The magnetoresistance studies also provide evidence for strong coupling of the magnetism to the conductivity. 11 refs., 7 figs.

30602 **(BNL—41033) Theory of oxygen content, atomic ordering and oxygen diffusion in 1,2,3 superconducting oxides as a function of temperature and oxygen pressure.** Bakker, H.; Westerveld, J.P.A.; Lo Cascio, D.M.R.; Welch, D.O. (Brookhaven National Lab., Upton, NY (USA); Amsterdam Univ. (Netherlands). Natuurkundig Lab.). 1988. Contract AC02-76CH00016. 4p. (CONF-880371—1).

From Japanese Institute Metals international sympsoium (JIMIS-5); Kyoto, Japan (14 Mar 1988).

In a previous paper we presented a thermodynamic model that describes the oxygen content and the atomic ordering as a function of temperature and oxygen pressure. In this paper the application of the model to neutron diffraction data by Jorgensen et al. will be given and the model is applied to the problem of the oxygen diffusion. 9 refs., 4 figs.

30603 **(CONF-880206—3) Ground state properties and electronic structure of high T/sub c/ superconductors.** Stocks, G.M.;Temmerman, W.M.;Szotek, Z.;Guo, G.Y.;Durham, P.J. (Oak Ridge National Lab., TN (USA); Daresbury Lab. (UK)). 1988. Contract AC05-84OR21400. 3p.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

We report the results of calculations of the ground state properties (equibrium volume, bulk modulus and antiferromagnetism) and the electronic structure of a number of high T/sub c/ su-

perconductors and related materials. The calculations are based on the local density approximation and were performed using the ASA-LMTO method. 8 refs.

30604 **(CONF-880481—2) Effects of grain boundary composition on properties of YBa_2Cu_3O/sub 7-x/.** Kroeger, D.M.; Brynestad, J.; Williams, R.K.; Padgett, R.A.; Scarbrough, J.O. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p.

From MRS high temperature superconductors; Reno, NV, USA (4 Apr 1988).

Results strongly suggest that the source of grain boundary resistance in sintered YBa_2Cu_3O/sub 7-x/ is a layer of material at grain boundaries which differs from the bulk in composition. If it is notsuperconducting as the composition determinations suggest, then transport between grains is by a tunneling process, as others have surmised from the field dependence of J/sub c/. The composition of the grain boundary layer is affected by small deviations from the stoichiometric composition. It is likely that the variations of J/sub c/(H) and {rho}(T) with sample composition are reflections of these changes in grain boundary composition. The variation of grain size with composition may be due to changes in grain boundary diffusion rates. We conclude that control of grain boundary composition is essential to improvement of J/sub c/. Sample homogeneity may be an important issue since local composition variations would be expected to lead to variations in grain boundary composition.

30605 **(CONF-880491—1) Ceramic specimen heating by induction power.** Liu, K.C. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 16p.

From Conference on mechanical testing of engineering ceramics at high temperatures; London, UK (11 Apr 1988).

Methods of heating a ceramic tensile specimen by induction power are presented. Due to the nonconductive nature of most ceramic materials the specimen heating is accomplished with the aid of a SiC susceptor, which is heated first by induction and, in turn, heats the specimen by thermal radiation. To improve the heating characteristics and facilitate routine testing, the basic heating configuration has been modified into a split clamshell-like furnace. It further demonstrated that simplicity, versatility, high heating efficiency, and the ease of access to the specimen for temperature and strain measurements are the unique features of this heating method. 5 figs.

30606 **(CONF-880491—2) Uniaxial tensile strain measurement for ceramic testing at elevated temperature: Requirements, problems and solutions.** Liu, K.C.; Pih, H.; Voorhes, D.W. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Engineering Science and Mechanics; OPTRA, Inc., West Peabody, MA (USA)). 1988. Contract AC05-84OR21400. 41p.

From Conference on mechanical testing of engineering ceramics at high temperatures; London, UK (11 Apr 1988).

Accuracy, sensitivity and resolution requirements for strain measurement on a tensile ceramic specimen at high temperature were studied. Results indicate that current techniques and existing equipment for strain measurement can be modified and upgraded for use in high temperature testing of ceramic materials. A versatile mechanical strain extensometer capable of performing both biaxial and uniaxial strain measurements at 1200{degree}c is presented. Results of tensile and fatigue tests using the devices are also given. Additionally, two laser-based, noncontact, optical strain extensometers currently under development are described. The first method utilized the diffraction phenomenon of a light beam passing through a narrow slit. Accuracy, long-term stability, and low cost are the virtues of this method which makes it attractive for creep testing. The second method measures the in-plane surface displacement in terms of the change in phase resulting from the interference of two orthogonally polarized collinear beams which differ in frequency by a constant value. The last method is ideally suited for dynamic strain measurement. 7 refs., 11 figs.

30607 **(DOE/ER/45321—1) Strong fibers: Progress report, July 15, 1987-July 14, 1988.** Johnson, H.H. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Mar 1988. Contract FG02-87ER45321. 12p.

The proposal submitted a year ago described an innovative program to use microfabrication technology to produce fibers of metals, ceramics, and intermetallic compounds with interesting mechanical and physical properties. The approach was to integrate advanced deposition processes such as reactive evaporation, eoevaporation, and sputtering with patterns generated by optical lithography to produce fibers with transverse dimensions in the micrometer range, and lengths from much less than a millimeter to several centimeters. This technology can also be used to produce two-dimensional grids and particulates of different sizes and geometries. This experimental approach allows an unprecedented control of dimensions, geometry, composition, and structure. The initial materials foci of the proposed program were alumina (Al_2O_3) and the mixed metal oxides of alumina with metal solutes, and intermetallic compounds such as the nickel and titanium aluminides. 5 fig.

30608 **(IC—87/278) Anomalous dependence of the thermoelectric power on the temperature in Y-BA-CU-O high-T/sub c/ superconducting samples.** Porjesz, T.; Karman, T.; Kirschner, T.; Kovacs, G.; Zsolt, G.; Beyer, H. (International Centre for Theoretical Physics, Trieste (Italy); Roland Eoetvoes Univ., Budapest (Hungary). Dept. for Low Temperature Physics; Central Research Inst. for Chemistry, Budapest (Hungary)). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702682/JAW.

Experimental thermoelectric measurements were carried out on high-T/sub c/ superconductors. The results have shown a p-type semiconductor-like conduction above the critical temperature and an n-type behaviour below it. (author). 3 refs, 4 figs.

30609 **(IC—87/308) Theoretical model of high temperature superconductors.** Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702707/JAW.

A theoretical model related to the mechanism of the interaction between superconductivity and the antiferromagnetism is developed. The critical temperature and the Neel temperature of doping systems are formulated as a function of that for undoped systems. This model is used to describe the behaviour of T/sub c/ in La/sub 2-x/Ba/sub x/Cu O/sub 4-y/. (author). 12 refs, 1 fig.

30610 **(IC—87/343) Dependence of high critical temperature of ceramic superconductors on the nominal $Cu^{3+}Cu^{2+}$ ratio.** Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702734/JAW.

The dependence of the superconducting-insulating transition (T/sub c/) and the insulator-metal transition (T-tilde/sub c/) on the nominal ratio tau of $Cu^{3+}Cu^{2+}$ has been estimated. This ratio tau ident to tau(δ), seems to guide the T/sub c/ by exhibiting a broad maximum, where the hole density δ has been formulated as a function of the doping-x and the oxygen deficiency-y. An agreement with the experimental results has been found. (author). 19 refs, 1 tab.

30611 **(LBL—24584) Plasma-assisted synthesis and physical chemical characterization of titanium nitride films.** Hilton, M.R. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 209p. NTIS, PC A10/MF A01;1; GPO Dep. Order Number DE88007365/JAW.

TiN films synthesized by radio-frequency plasma-assisted chemical vapor deposition onto M2 tool steel were investigated. $TiCl_4$ with NH_3 or with H_2 and N_2 were used 0.2 to 1.0 torr. Film composition, structure, and mechanical properties were strongly influenced by chlorine concentration within the film and at the film-substrate interfaces. Chlorine concentration in the films decreased with increasing deposition temperature. A transition from an amorphous zone one morphology, to a fine-grained zone T morphology, to a highly crystalline zone two morphology with (200) preferred orientation was observed with increasing deposition temperature. Films formed at temperatures lower than 400°C exhibited poor mechanical properties. At 400°C and above, film adhesion was influ-

enced by initial deposition conditions. Films formed from $TiCl_4$ and NH_3 had low scratch adhesion test critical loads, with fracture occurring at the interface. Auger analysis of scratch tracks created in vacuum revealed a high interfacial chlorine content. IN contrast, films synthesized with H_2 and N_2 exhibited higher scratch adhesion test critical loads, with fracture within the film. Auger depth profilng revealed no chlorine accumulation at the interfaces of H_2-N_2-based films. Early film growth was accompanied by TiN islands. A plasma was essential for TiN synthesis from $TiCl_4$, H_2, and N_2. The chlorine concentrations of titanium carbonitride films, synthesized in a plasma with the addition of CH_4 showed greater variation at fixed deposition temperature than those of pure nitride films. The use of an organometallic source, titanium tetrakis dimethylamide, $Ti(N(CH_3)_2)_4$, resulted in the formation of carbonitride powders. 140 refs., 88 figs.

30612 **(LBL—24869) Specific heat of $YBa_2Cu_3O_7$.** Fisher, R.A.;Gordon, J.E.;Kim, S.;Phillips, N.E.;Stacy, A.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 10p. (CONF-880206—2). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007372/JAW.

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

The specific heats of five $YBa_2Cu_3O_7$ samples were measured in the range 0.4-100K in fields of 0, 3.5 and 7T. For two samples Cr was partially substituted for Cu. This produced only a small decrease in T/sub c/ (0.35 Kmole % Cr) but a strong suppression of the Meissner effect and {triangle}CT/sub c/, which provided a basis for estimating the normal-state specific heat near T/sub c/. A third sample had Cr present in an impurity phase. Two undoped samples showed evidence of fluctuation effects near T/sub c/. A comparison of these results with other work is given. 32 refs., 4 figs., 2 tabs.

30613 **(ORNL/Sub—86-57598/1) An assessment of the state of the art in predicting the failure of ceramics: Final report.** Boulet, J.A.M. (Tennessee Univ., Knoxville (USA). Dept. of Engineering Science and Mechanics). Mar 1988. Contract AC05-84OR21400. 60p.

The greatest weakness in existing design strategies for brittle fracture is in the narrow range of conditions for which the strategies are adequate. The primary reason for this weakness is the use of simplistic mechanical models of fracture processes and unverified statistical models of materials. To improve the design methodology, the models must first be improved. Specifically recommended research goals are: to develop models of cracks with realistic geometry under arbitrary stress states; to identify and model the most important relationships between fracture processes and microstructural features; to assess the technology available for acquiring statistical data on microstructure and flaw populations, and to establish the amount of data required for verification of statistical models; and to establish a computer-based fracture simulation that can incorporate a wide variety of mechanical and statistical models and crack geometries, as well as arbitrary stress states. 204 refs., 2 tabs.

30614 **(ORNL/TM—10606) An investigation of ceramic coatings for protection of SiC from high-temperature corrosion.** Federer, J.I. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 46p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007873/JAW.

Silicon carbide (SiC) ceramics are susceptible to corrosion by certain industrial furnace environments. this behavior would limit the use of SiC components in ceramic heat exchangers. Because oxide ceramics corrode substantially less in the same environments, ceramic coatings have been investigated for corrosion protection. Coatings with Al_2O_3, SiO_2, or ZrO_2 as the main constituent were applied to sintered alpha and recrystallized (CS101) SiC substrates. The coated specimens were thermally cycled between room temperature and 1200{degree}C as a test of adherence. Some coatings adhered better to the inherently rougher CS101 SiC;however, most coatings did not adhere to either substrate. Two Al_2O_3-based coatings developed cracks but remained intact during thermal cycling, and two ZrO_2-based coatings were adherent without cracks. These four coatings were subjected to corrosion testing at 1200{degree}C in an oxidizing atmosphere containing Na_2CO_3. None of these four coatings exhibited the desired corrosion resistance in this test. Coated samples, however, corroded less than an uncoated sample, indicating that coatings can improve corrosion resistance. 19 figs., 7 tabs.

30615 **(PB—88-861463/XAB) Silicon nitride ceramics and refractories. April 1984-March 1988 (citations from the NTIS data base). Report for April 1984-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 113p. NTIS PC N01/MF N01.

Supersedes PB—87-856423.

This bibliography contains citations concerning the properties, preparation, fabrication, testing, and applications of silicon nitride. Applications include utilization in gas-turbine components and heat exchangers. Sintering methods and materials, and microstructural analyses are discussed. (This updated bibliography contains 207 citations, 48 of which are new entries to the previous edition.)

30616 **(PNL-SA—15072) Environmental effects on slow crack growth in silicon nitride.** Henager, C.H. Jr.; Jones, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 13p. (CONF-880118—3).

From 12. annual conference on composites and advanced ceramics; Cocoa Beach, FL, USA (20 Jan 1988).

Slow crack growth measurements are being conducted to determine crack velocity versus stress intensity as a function of chemical environment in advanced ceramic materials. Controlled, artificial flaws are placed in the flat tensile faces of hot pressed Si_3N_4 tensile specimens (2.3 x 2.3 x 21.6 mm gage) and oriented to open in mode I on tensile loading. Tests have been performed in air and without a coating of sodium sulfate at 1573°K. results indicate that slow crack growth in the presence of sodium sulfate is about twice as fast as in air. 5 refs., 5 figs.

30617 **(SAND—88-0060C) Paramagnetic spins in oxygen-loaded ceramic La_2CuO/sub 4+δ/.** Venturini, E.L.; Schirber, J.E.; Morosin, B.; Ginley, D.S.; Kwak, J.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880408—3). NTIS, PC A; Q 02/MF A01;1; GPO Dep. Order Number DE88007114/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Annealing ceramic La_2CuO/sub 4+δ/ in 3 kbar of oxygen at 600°C increases the weight by 0.35%, produces a bulk superconductor with a ≃30% Meissner fraction, and adds a new component to the paramagnetic susceptibility which is characteristic of localized, paramagnetic spins. Analytical chemistry suggests that the stoichiometry of this HP-annealed ceramic is La_2CuO/sub 4.14/, where at least part of the additional oxygen is incorporated as superoxide ions, O_2^-. The additional paramagnetic spins from the susceptibility data, 1.3(3) x 10^{20} spins/g, agree with the number of superoxide ions inferred from weight gain and iodometric analysis. 14 refs., 2 figs.

30618 **Grain-boundary compositions in $YBa_2Cu_3O_7$√/sub x/ from Auger electron spectroscopy of fracture surfaces.** Kroeger, D.M.; Choudhury, A.; Brynestad, J.; Williams, R.K.; Padgett, R.A.; Coghlan, W.A. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Applied Physics;* **64**: No. 1, 331-335(1 Jul 1988).

Comparison of Auger electron spectra obtained from intergranular and transgranular areas exposed on fracture surfaces of sintered $YBa_2Cu_3O_7$√/sub x/ specimens indicates that most grain-boundary surfaces are deficient in oxygen and rich in copper compared to the bulk. The thickness of this region of altered composition is estimated to be in the range of 15—50 A. No evidence of segregation of impurities to grain boundaries was seen. The results suggest that the grain-boundary layer is nonsuperconducting and a likely contributor to the problem of low critical current densities in these materials. It is believed that carbon at grain boundaries which has been reported results from incomplete calcination in material which is slightly off stoichiometry.

30619 High-energy elastic backscattering of helium ions for compositional analysis of high-temperature superconductor thin films. Martin, J.A.; Nastasi, M.; Tesmer, J.R.; Maggiore, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **52**: No. 25, 2177-2179(20 Jun 1988).

A thin-film technique for measuring the chemical composition of Y-Ba-Cu-O thin films to a few percent accuracy is described. This technique utilizes non-Rutherford backscattering of 8.8 MeV helium ions, which has an increased sensitivity ^{16}O by a factor of 25 over Rutherford backscattering spectrometry. The ratios of the cross sections for He^{++} scattered from oxygen, copper, and yttrium relative to barium are easily determined using thin-film standards that can be fabricated in any deposition system capable of producing thin-film superconductors. The technique does not require the constant use of standards or accurate charge determination.

30620 Galvanomagnetic luminescence and the quantum efficiency of radiative recombination of InSb. Berdahl, P. (Applied Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **63**: No. 12, 5846-5858(15 Jun 1988). Contract AC03-76SF00098.

The galvanomagnetic luminescence (GML) technique is used to determine carrier lifetimes in pure and doped InSb samples near room temperature. For this purpose the theory of the GML effect is derived. The Onsager reciprocity relation between the GML effect and the photoelectromagnetic effect is also derived. (Furthermore, a related connection is obtained between the thermophotovoltaic effect and light emission by diodes.) The experimental data yield lifetimes in the range of 70 ps to 30 ns. Based on these lifetimes the quantum efficiency eta/sub q/ for an excess electron-hole pair to produce a photon is determined. For intrinsic samples, eta/sub q/ = 3% at 20 °C and 1.5% at 70 °C. Some p-type samples have values of eta/sub q/ as high as 5%. These results show that p-type doping can suppress the dominant Auger recombination mechanism in intrinsic InSb.

30621 High critical field anisotropy of superconducting Bi-Sr-Ca-Cu oxide from highly oriented thin films. Kang, J.H.; Kampwirth, R.T.; Gray, K.E. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **52**: No. 24, 2080-2082(13 Jun 1988).

Superconducting films of Bi-Sr-Ca-Cu oxides have been grown on MgO substrates by multitarget magnetron sputtering. After post-annealing in an oxygen atmosphere, zero resistance was obtained at about 80 K. X-ray diffraction indicates a high degree of preferential growth of the c axis perpendicular to the substrate. Measurements of the upper critical field B/sub $c/_2$(T) of these films show critical field slopes (B/sup '//sub $c/_2$equivalent-dB/sub $c/_2$dT at T/sub c/) of 8.5 and 0.56 TK, respectively, for B parallel and perpendicular to the substrate. The anisotropy of ~15 and the B/sub $c/_2$/sub parallel/ are the highest values yet reported for high-temperature superconductors.

30622 Time-temperature-transformation diagram for the orthorhombic to tetragonal phase transition in $YBa_2Cu_3O_7$√/sub partial/. Shi, D.; Capone II, D.W.; Goretta, K.C.; Zhang, K.; Goudey, G.T. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Applied Physics;* **63**: No. 11, 5411-5414(1 Jun 1988). Contract W-31-109-ENG-38.

An isothermal transformation curve marking the orthorhombic (O) to tetragonal (T) phase transition boundary has been established over a wide temperature range. There exists within the time-temperature-transformation diagram two distinct and separate regions containing superconducting samples with narrow 90- and 60-K transition temperatures, respectively. An oxygen diffusion coefficient at 300 °C in these materials is estimated based on isothermal data. The kinetic process of the T-O transformation is studied. It is found, at all temperatures investigated, that extended annealing reduces the normal-state conductivity of the material and that the best samples are produced for intermediate annealing times.

30623 Microwave surface resistance of YBa_2Cu_3O/sub 6.9/ superconducting films. Martens, J.S.; Beyer, J.B.; Ginley, D.S. (University of Wisconsin—Madison, Department of Electrical and Computer Engineering, Madison, Wisconsin 53706). *Applied Physics Letters;* **52**: No. 21, 1822-1824(23 May 1988).

The microwave surface resistance of an YBa_2Cu_3O/sub 6.9/ superconducting thick film was measured over the range 7.0—16.7 GHz at 77 K. This was done by placing a sample in a TE_{01}/sub n/ wavemeter cavity and observing the change in selectivity of the cavity. The material's surface resistance is of the same order of magnitude as that of silver at 77 K from 8 to 12 GHz and improves about another order at 4.2 K. The power-law behavior of surface resistance with frequency is probably close to quadratic. This is similar to the behavior of low critical temperature superconductors.

30624 High sensitivity of positrons to oxygen vacancies and to copper-oxygen chain disorder in $YBa_2Cu_3O_7$√/sub x/. von Stetten, E.C.; Berko, S.; Li, X.S.; Lee, R.R.; Brynestad, J.; Singh, D.; Krakauer, H.; Pickett, W.E.; Cohen, R.E. (Brandeis University, Waltham, Massachusetts 02254). *Physical Review Letters;* **60**: No. 21, 2198-2201(23 May 1988).

Temperature-dependent positron-electron momentum densities have been studied by two-dimensional angular correlation of annihilation radiation from 10 to 320 K in $YBa_2Cu_3O_7$√/sub x/ samples. The positron ground-state charge density, computed by the linearized augmented plane-wave method, indicates that in $YBa_2Cu_3O_7$ delocalized positrons sample preferentially the linear copper-oxygen chains. Positron localization due to disorder in these chains is invoked to explain the striking differences observed between superconducting ($x \approx 0.02$) and nonsuperconducting ($x \approx 0.70$) samples.

30625 Electronic structure and magnetism of $Nd_2Fe_{14}B$ and related compounds. Sellmyer, D.J.; Engelhardt, M.A.; Jaswal, S.S.; Arko, A.J. (Behlen Laboratory of Physics, University of Nebraska, Lincoln, Nebraska 68588-0111). *Physical Review Letters;* **60**: No. 20, 2077-2080(16 May 1988).

The electronic and magnetic structures of $Nd_2Fe_{14}B$ and related compounds have been studied with photoemission spectroscopy and self-consistent spin-polarized electronic structure calculations. The positions of the exchange-split Fe 3d bands and the localized 4f levels were determined. The densities of states in the ferromagnetic and paramagnetic states are essentially identical which provides strong evidence for considerable magnetic short-range order above T/sub c/, as in the fluctuating-band model of itinerant-electron magnetism.

30626 Properties of amorphous Zr_3RhH/sub x/ prepared from glassy and crystalline alloys. Bowman R.C. Jr.; Cantrell, J.S.; Samwer, K.; Tebbe, J.; Venturini, E.L.; Rush, J.J. (Chemistry and Physics Laboratory, The Aerospace Corporation, P.O. Box 92957, Los Angeles, California 90009-2957). *Physical Review [Section] B: Condensed Matter;* **37**: No. 15, 8575-8587(15 May 1988).

The electronic, magnetic, and thermal properties have been measured on the amorphous hydride phases prepared from originally glassy or crystalline Zr_3Rh alloys. The a-Zr_3RhH/sub x/ samples with $x \leqq 5.5$ were studied by x-ray diffraction, proton nuclear magnetic resonance, magnetic susceptibility, low-temperature heat capacity, differential scanning calorimetry, and inelastic neutron scattering. All hydride samples are amorphous with similar properties which are shown to be independent of the structure for the initial alloy. Namely, the solid-state reaction of hydrogen with crystalline c-Zr_3Rh appeared to produce an equivalent amorphous phase to hydrogenated glassy alloys. The changes in the electronic and magnetic properties upon hydrogenation imply a systematic decrease in the Fermi-level density of states in a-Zr_3RhH/sub x/ as the hydrogen content x increases. The thermal stabilities of the amorphous hydrides (with respect to the irreversible formation of crystalline ZrH/sub x/ phases) also decrease with increasing hydrogen stoichiometry. Whereas the hydrogen atoms predominantly occupy tetrahedral interstitial sites coordinated with zirconium atoms, there is strong circumstantial evidence for occupancies of different and less stable sites for compositions with higher hydrogen content.

30627 Effect of oxygen pressure on the orthorhombic-tetragonal transition in the high-temperature superconductor YBa$_2$Cu$_3$O/sub x/. Specht, E.D.; Sparks, C.J.; Dhere, A.G.; Brynestad, J.; Cavin, O.B.; Kroeger, D.M.; Oye, H.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7426-7434(1 May 1988).

High-resolution in situ x-ray-diffraction measurements were made of the lattice constants of YBa$_2$Cu$_3$O/sub x/ as it was heated and cooled through the orthorhombic-tetragonal transition at a series of O_2 pressures. The transition is sharp, continuous, and reversible in temperature and pressure. As O_2 pressure is reduced from 1.0 to 0.005 atm, the transition temperature falls from 676 +- 5 °C to 521 +- 10 °C while oxygen content at the transition falls from 6.66 +- 0.01 to 6.59 +- 0.02. Dilation along the c axis is observed as oxygen is removed. Under helium, an irreversible but time-dependent orthorhombic-to-tetragonal transition occurs during heating.

30628 Joint x-ray and neutron refinement of the structure of superconducting YBa$_2$Cu$_3$O$_7$√/sub x/: Precision structure, anisotropic thermal parameters, strain, and cation disorder. Williams, A.; Kwei, G.H.; Von Dreele, R.B.; Raistrick, I.D.; Bish, D.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7960-7962(1 May 1988).

X-ray and neutron powder diffraction data for superconducting orthorhombic YBa$_2$Cu$_3$O$_7$√/sub x/ have been used in a joint refinement to give a room-temperature structure which includes a very precise set of atom positions and thermal-motion parameters. Broadening of the diffraction peaks indicates that these materials are highly strained, and contrary to a number of suggestions in the literature, no evidence is found for any cation disorder.

30629 Reentrant softening in perovskitelike superconductors. Datta, T.; Ledbetter, H.M.; Violet, C.E.; Almasan, C.; Estrada, J. (Department of Physics and Astronomy, University of South Carolina, Columbia, South Carolina 29208). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7502-7505(1 May 1988).

We suggest a model: reentrant elastic softening: that achieves three useful results. First, and principally, it reconciles existing sound-velocity—elastic-constant measurements with thermodynamics. Second, it leads to Debye characteristic temperatures that agree with those from specific-heat and phonon density-of-states determinations. Third, it links elastic-constant—temperature behavior in Y-Ba-Cu-O and La-Sr-Cu-O. The model predicts a superconducting-state elastic stiffness lower than the normal state.

30630 Static and dynamic spin correlations in pure and doped La$_2$CuO$_4$. Endoh, Y.; Yamada, K.; Birgeneau, R.J.; Gabbe, D.R.; Jenssen, H.P.; Kastner, M.A.; Peters, C.J.; Picone, P.J.; Thurston, T.R.; Tranquada, J.M.; and others. (Department of Physics, Tohoku Universtiy, Sendai 980, Japan). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7443-7453(1 May 1988).

We report elastic, quasielastic ($\int$ dE), and inelastic neutron-scattering studies of the instantaneous and dynamic spin fluctuations in as-grown and doped La$_2$CuO$_4$. Four samples have been studied: (A) as-grown La$_2$CuO$_4$ with T/sub N/ = 195 K, (B) oxygenated La$_2$CuO$_4$ with T/sub N/≅100 K, (C) La$_2$Cu/sub 0.95/Li/sub 0.05/O$_4$, and (D) La/sub 1.97/Sr/sub 0.03/Cu/sub 0.95/Li/sub 0.05/O$_4$. All crystals exhibit variable-range-hopping conductivity behavior. At room temperature each sample exhibits two-dimensional (2D) antiferromagnetic instantaneous correlations in the CuO$_2$ sheets with correlation length varying from ~200 A in crystal A to ~14 A in crystal D. The integrated intensity and therefore the effective moment is, however, constant to within the experimental error. In samples A and B the 2D correlation length becomes sufficiently large with decreasing temperature that the interplanar coupling is able to drive a transition to 3D long-range order. The spin dynamics have been studied in detail in crystals A and B and quite unusual behavior is observed. In contrast to previously studied planar antiferromagnets, there is no significant E≅0 component for temperatures ≧T/sub N/ and instead the 2D response function is highly inelastic. The effective dispersion of the spin excitations is ≧0.4 eV A. This large energy scale for the spin fluctuations gives credence to models of the superconductivity in doped La$_2$CuO$_4$ in which the pairing is magnetic in origin.

30631 Magnetic interaction between rare-earth moments in high-temperature superconductors RBa$_2$Cu$_3$O$_7$√/sub x/. Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7470-7471(1 May 1988).

It is shown on the basis of a simple model that a modified Ruderman-Kittel-Kasuya-Yosida interaction involving electrons at energies away from the Fermi level can stabilize the three-dimensional magnetic order of the rare-earth moments in RBa$_2$Cu$_3$O$_7$√/sub x/, where R = Gd and possibly Sm, Dy. The interaction favors antiferromagnetism.

30632 Layer plasmons and high-T/sub c/ superconductivity. Kresin, V.Z.; Morawitz, H. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California at Berkeley, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 13, 7854-7857(1 May 1988).

We study a layered electron-gas model for the high-T/sub c/ copper oxides. The formation of plasmon bands by the interlayer Coulomb interaction is shown to lead to enhanced plasmon-induced electron pairing at the boundaries of the plasmon bands. We comment on the potential contribution of quasi-one-dimensional plasmons for the YBa$_2$Cu$_3$O$_7$√/sub δ/ compounds. The concept of coexistence of phonon and plasmon mechanisms is discussed.

30633 Time-dependent magnetic measurements in a 90-K Y/sub 1.2/Ba/sub 0.8/CuO/sub 4-δ/ superconductor. Hor, P.H.; Meng, R.L.; Chu, C.W.; Wu, M.K.; Zirngiebl, E.; Thompson, J.D.; Huang, C.Y. (Univ. of Houston, TX (USA)). *Applied Physics Communications;* **7**: No. 3, 123-127(Sep 1987).

It has been shown that the magnetic moment of Y/sub 1.2/Ba/sub 0.8/CuO/sub 4-δ/, a 90-K superconductor, is time dependent. To measure the time dependence of the magnetic moment, the temperature was varied while the applied magnetic field was held constant at 75G.

3606 Other Materials

REFER ALSO TO CITATION(S) 29982, 30011, 30362, 30481, 30493, 30517, 30536, 30596, 30740, 30780, 30870, 30896, 30901, 30905, 31019, 31221, 31722, 31758, 31773

30634 (AD-A—189197/7/XAB) Nonlinear materials (TAS). Final report, May 1986-November 1987. Auyeung, R. (Geo-Centers, Inc., Newton Upper Falls, MA (USA)). 29 Jan 1988. 35p. (GC-TR—88-1716). NTIS, PC A03/MF A01.

This report describes the investigation of frequency-conversion techniques using the non-linear crystalline material thallium arsenide (TAS). The procedures for the successful generation of frequencies through the fifth harmonic are described, as well as a discussion of optimization of laser output at each frequency.

30635 (AD-A—189414/6/XAB) Phase velocity and attenuation of plane elastic waves in a particle-reinforced composite medium. Datta, S.K.; Ledbetter, H.M.; Shindo, Y.; Shah, A.H. (Colorado Univ., Boulder (USA). Dept. of Mechanical Engineering). Aug 1987. 26p. (CUMER—87-3). NTIS, PC A03/MF A01.

This study considered effective-plane-wave propagation, both longitudinal and shear, through a medium containing a random distribution of spherical inclusions. It was assumed that the particles and matrix are separated by a thin layer of elastic material with different properties. For some systems, the authors predict measurable effects for the thin layers. Especially, they considered lead/epoxy and silicon carbide/aluminum. The object of this study was to explore the practicality of using ultrasound to characterize properties of interface layers. Ultrasound is a practical tool for

measuring properties of, and characterizing the state of, a material with microstructure (or changes in microstructure).

30636 **(AD-A—189459/1/XAB) Investigation of energy-transfer processes in Nb-compensated CaMoO4:Nd(3+) crystals.** Elouadi, B.; Powell, R.C.; Holt, S.L. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Solid State Chemistry, Vol. 69, 369-375(1987).

The temperature dependence and time evolution of fluorescence were studied for samples of CaMoO4:YNbO4 and CaMoO4:NdNbO4 and the results are used to characterize the thermal quenching and host-sensitized energy-transfer properties of these materials. Doping with YNbO4 is found to enhance the room-temperature luminescence yield of CaMoO4. Efficient host-sensitized energy transfer to Nd^{3+} ions was observed in CaMoO4:NdNbO4, and the fluorescence lifetime of Nd(3+) was found to be close to its radiative lifetime in this host.

30637 **(AD-A—189485/6/XAB) Equation of state of InP to 19 GPa.** Menoni, C.S.; Spain, I.L. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 35, No. 14, 7520-7525(15 May 1987).

X-ray-diffraction experiments have been carried out on InP at room temperature to pressures of 19 GPa. The compression curve for the zinc-blende phase (I) was found to fit the Murnaghan equation up to 10.8 GPa where a transformation to the rocksalt structure was observed. Values for the bulk modulus, B(10) and its pressure derivative, B(10) at P = 0 obtained by a best-fit procedure to the Murnaghan equation were B(10) = 76 + or - 4 GPa and B(10) = 4 + or - 0.2. These values are similar to those obtained from precision elastic-constant measurements. Analogous parameters for the rocksalt phase (II) were obtained with reference to the transition pressure B(IIt) = 130 + or - 10 GPa,B(IIt) = 1.6 + or - 0.1. At 19 GPa, a further transformation was observed to a phase which was tentatively identified as beta-Sn-like. Data for these three phases are given and discussed in terms of models for the transitions.

30638 **(AD-A—189600/0/XAB) Optical study of germanium, germanium-plus-arsenic, and germanium-plus-gallium implants in gallium arsenide. Master's thesis.** Alley, T.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 108p. (AFIT/GEP/ENP—87D-1). NTIS, PC A06/MF A01.

The low-temperature photoluminescence (PL) properties of single implants of Germanium and dual implants of Ge+arsenic or Ge+gallium into semi-insulating chromium-doped gallium arsenide were analyzed. Room-temperature implantation was performed at 120 keV. When dual implantation was used, samples were implanted at the same dose and energy. Ion doses ranged from 1 x 10^{13} to 1 x $10^{15}/cm^2$. Samples were encapsulated with silicon nitride and then annealed at temperatures ranging from 700 to 950 C. Si_3N_4 was removed prior to PL measurements. A PL peak due to Ge acceptors was identified. A bound-exciton peak related to Ge donors was also observed. An acceptor peak due to residual silicon was found in all samples. The heights of the Ge-acceptor peak and exciton peak were compared to the height of the intrinsic Si-acceptor peak. The height comparison was used in an effort to find trends of Ge-acceptor and Ge-donor transitions as a function of anneal temperature and ion dose.

30639 **(AD-A—189629/9/XAB) Strength and failure analysis of composite laminate containing a circular hole with reinforcement. Master's thesis.** Lee, J.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 116p. (AFIT/GAE/AA—87D-9). NTIS, PC A06/MF A01.

Tension and compression tests of quasi-isotropic, graphite/epoxy laminate containing a circular hole with reinforcement was conducted using an Instron static-testing machine. Two types of reinforcement boundary conditions were investigated; adhesive band reinforcement and snug-fit unbonded plug. For each case boundary conditions, four different sizes of hole diameter and three types of reinforcing material (aluminum, plexiglass, steel) were employed for investigation. The experiments were mainly focused on the evaluation of ultimate strength of reinforced panels relative to the case of open hole. In addition to this, the failure mechanism analysis for both boundary conditions were studied. To help designers and users of composites, previously available theoretical fracture models and their comparison with the present experimental results are also discussed.

30640 **(AD-A—189642/2/XAB) Structure and surface characterizations of high-strength carbon fibers. Final report.** Lin, S.S.; Yip, P.W. (Army Materials Research Agency, Watertown, MA (USA). Materials Technology Lab.). Sep 1987. 21p. (MTL-TR—87-49). NTIS, PC A03/MF A01.

Six commercial carbon fibers are characterized by x ray diffraction, scanning electron microscopy (SEM) and x ray photoelectron spectroscopy (XPS), or Electron Spectroscopy for Chemical Analysis (ESCA). Physical, structural, and surface parameters required to describe major properties of carbon fibers are examined and discussed. The correlation of these parameters is essential for developing optimizing and desired carbon-composite materials.

30641 **(AD-A—189732/1/XAB) Time-resolved photoluminescence in InP doping superlattices.** Ranganathan, R.; Gal, M.; Viner, J.M.; Taylor, P.C. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 1986. 5p. NTIS, PC A02/MF A01.

Pub. in International Conference on Physics of Semiconductors (18th), 763-766(1986).

Spectrally resolved studies of the time decay of the PL in InP superlattices are presented. These measurements permit one to follow the time evolution of the internal electric fields after intense optical excitation and yield information on recombination rates for spatially separated electrons and holes in different subband levels.

30642 **(AD-A—189826/1/XAB) Experimental studies on electronic properties of HgTe/CdTe and Hg(1-x)Cd(x)Te/CdTe heterostructures and superlattices. Final report, 1 March 1984-30 September 1987.** Ong, N.P. (Princeton Univ., NJ (USA). Dept. of Physics). 10 Dec 1987. 3p. NTIS, PC A02/MF A01.

The electronic properties of superlattices made of alternating layers of mercury telluride and cadmium telluride were studied at low temperatures T (down to 0.5 K) and in high dc magnetic fields (up to 29 T.) There were two motivations for performing these studies. 1) Whereas superlattices made from III-V materials such as Aluminum Gallium Arsenides and Indium Phosphide have been fabricated and shown to support very high mobility electrons in two-dimensional wells, similar studies had not been performed on the II-VI compounds. In 1982, Dr. Jeff Cheung at Rockwell, Thousand Oaks, succeeded in fabricating superlattices of HgTe and CdTE using a novel laser-flash-evaporation technique. Initial studies by the group (then at University of Southern California) showed that prospects looked good for realizing excellent two-dimensional electronic devices despite the poor mobility of the early samples. 2) On the practical side, far-infrared (FIR) detectors made from the bulk alloy Hg(1-X)Cd(X)Te suffer from inhomogeneity problems which lead to spatial variations of the gap, especially in the 10 micrometer range. Following suggestions by McGill and Schulman (that the gap superlattice HgTe-CdTe can be tuned by changing the periodicity) the author also explored the FIR capabilities in the Rockwell samples. He made very extensive studies of the weak localisation effects that could be observed in the weak-field magnetoresistance in fields under 40 gauss. By fitting the data to the theory of Hikami et al we extracted quite convincing numbers for the spin-orbit scattering rate and the inelastic-scattering rate.

30643 **(AD-A—189846/9/XAB) Fracture-toughness testing of a ceramic-matrix composite. Master's thesis.** Vozzola, R.P. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 105p. (AFIT/GAE/AA—87D-24). NTIS, PC A06/MF A01.

The need for an accurate fracture-toughness testing technique for fiber-reinforced ceramic composites was identified. A technique was developed to measure small-crack-mouth displace-

ments over small gauge lengths of small glass-ceramic composite specimens during loading. The technique was applied to Mode II crack propagation. A loading fixture capable of exerting and measuring small loads was developed. A technique to measure compliances in small composite specimens was perfected. The validity of using a laser-based interferometric technique to determine the instant of crack initiation was studied. Finally, the Mode II critical-strain energy-release rate of interlaminar delamination growth was evaluated. Sample results for a 1723 glass-matrix, silicon carbide fiber composite are included, and recommendations for further study are described.

30644 **(AD-A—189886/5/XAB) Hermetic coating of optical fibers. Final report, October 1984-June 1986.** Raychaudhuri, S.; Levin, P.S.; Sierra, R. (Spectran, Inc., Sturbridge, MA (USA)). Nov 1987. 46p. NTIS, PC A03/MF A01.

Hermetically coated graded-index silica fibers were to exhibit proof-test levels greater than 200 Kpsi over one kilometer length. Fiber was to exhibit a stress-corrosion factor N greater than 100. The dielectric coating materials were to include, but not limited to diamond-like carbon and boron nitride. Techniques using hollow-cathode discharge coater produced coated fiber with N value less than 26. Severe arcing problems were faced with this technique resulting in large cracks on the coater anodes. RF plasma coater was built and operated to deposit amorphous hydrogenated carbon (a - C:H) films both on bulk-deposition fiber samples. Fibers were drawn under a number of conditions to determine the role, such factors as vacuum chamber alignment, tension, plasma conditions to determine the role, such factors as vacuum chamber alignment, tension plasma conditions play in the strength of the fiber. A stress corrosion susceptibility factor N = 26 was obtained. In only preliminary experiments with the deposition of silicon nitride coating on the fiber, N values up to 70 were achieved.

30645 **(BNL—40564) Insulating LNG [liquified natural gas] storage tank containment dikes with a lightweight polymer concrete.** Fontana, J.J. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 20p. (CONF-880474—1).

From 5. tri-annual conference on corrosion and construction; Las Vegas, NV, USA (5 Apr 1988).

The natural gas industry has always been concerned ith accidental spills of liquified natural gas (LNG) from storage tanks into surrounding containment dikes. The LNG that is leaked to the dike area boils off and the vapors mix with the atmosphere forming a hazardous explsoive mixture within the dike walls. These hazardous mixtures can travel long distances into industrial or residential areas surroungind LNG storage facilities. Studies by the natural gas industry indicate that the hazards associated with accidental spills of LNG from storage tanks can be makedly reduced by insulating the diked areas surrounding these tanks. In this manner, the heat transfer from the dike surface to the LNG is reduced. The insulating composite is used to construct a thermal barrier between the walls and floor of the dike an the spilled LNG. The thermal conductivity, porosity, and compression strength of a concrete, polymer composite insulating material is discussed. 6 refs., 8 figs., 5 tbs.

30646 **(CEA-R—5419) Characterization of the native defects in HgTe, CdTe, Hg/sub 1-x/, Cd/sub /xTe by positron annihilation: evidence of native vacancies.** Geffroy, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Dec 1987. 176p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753478/JAW.

Direct evidence of native vacancies is found in as-grown Cd/sub x/Hg/sub 1- /xTe single crystals prepared by the travelling heating method (THM). The vacancies have characteristics depending on the annealing undergone by the crystals after their growth and on the conduction type in the crystals. In as-grown CdTe and Cd/sub 0.7/Hg/sub 0.3/Te (THM), native vacancies are found in n-type materials. In as-grown HgTe and Cd/sub 0.2/Hg/sub 0.8/Te (THM), native vacancies are found in p materials. They disappear after stoechiometric annealings in which the crystals are converted n-type. From the positron lifetime at the vacancies, 320+-4 ps, one can show that the native vacancies are metallic vacancies V/sub Cd/ in CdTe, V/sub Hg/ in HgTe, V/sub Hg/ orand V/sub Cd/ in Cd/sub x/Hg/sub 1-x/Te alloys. The concentration of the metallic vacancies is estimated in as-grown crystals. In as-grown p-type CdTe and Cd/sub 0.7/Hg/sub 0.3/Te (THM), in as-grown then subsequently p-type annealed HgTe and Cd/sub 0.2/Hg/sub 0.8/Te (THM), vacancy type defects are also found giving rise to lifetime of about 290 ps. These defects are also found in crystals grown by Bridgman method. The nature of these defects is discussed. The In doping effects on the metallic vacancies have been studied. It is shown that In addition increases the concentration of metallic vacancies in CdTe (In) (THM). Vacancy-In complexes appear for In concentrations of the order or above 10^{17} cm^{-3}. These complexes disappear after decompensating annealings and only the metallic vacancies survive. Small vacancies clusters of two or three vacancies are found after deformation at room temperature in CdTe (Mn) (THM).

30647 **(CONF-880311—1) Photoluminescence studies of InGaAlAs quaternary alloys.** Jones, E.D.; Dawson, L.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 11p.

From Advances in semiconductors and superconductors: physics and device applications; Newport Beach, CA, USA (13 Mar 1988).

Photoluminescence data are used to obtain the concentration and temperature dependence of the bandgap energies of epitaxial layers of quaternary alloy In/sub 0.1/Ga/sub x/Al/sub y/As for Al concentrations less than 0.6. The samples were grown by MBE without an intervening buffer layer. For an In concentration of 0.1, the transition from a direct to an indirect bandgap material occurs for an Al concentration of about 0.5. Coefficients of the temperature dependence of the bandgap energy are also presented. 14 refs., 3 figs., 1 tab.

30648 **(CONF-880671—1) Chemical compatibility between silicon carbide and a nickel aluminide.** Nieh, T.G.; Stephens, J.J.; Wadsworth, J.; Liu, C.T. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA (USA). Research and Development Div.; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 10p.

From International conference on composite interfaces; Cleveland, OH, USA (13 Jun 1988).

The chemical compatability between a nickel aluminide (IC-50) and silicon carbide, in both fiber and bulk forms, has been studied over the temperature range from 700 to 1100{degree}C. In general, there are four reaction layers formed at the interface. The elemental distribution in each layer was analyzed using electron microprobe techniques. Nickel is apparently the dominant diffusing species controlling the overall reaction. The chemical reaction between SiC and nickel aluminide is similar to that between SiC and Ni-base superalloys. Aluminum oxide is an effective diffusion barrier in inhibiting SiC-nickel aluminide reaction. 26 refs., 7 figs., 2 tabs.

30649 **(CONF-8711158—) Workshop report and presentations from the Semiconductor Research Corporation-DOE Semiconductor Task Force workshop.** (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 210p.

From Semiconductor Research Corporation/DOE Semiconductor Task Force workshop; Oak Ridge, TN, USA (2 Nov 1987).

The Semiconductor Research Roproation-DOE Semiconductor Task Force Workshop was held in Oak ridge, Tennessee, on November 2-3, 1987. The purpose was to provide aforum for representatives of the national laboratories, the Department of Energy, and the semiconductor industry to discuss capabilities of the national laboratories which could industry to discuss capabilities of the national laboratories which could contribute to the future competitiveness of the US semiconductor industry, to identify specific large and small projects at the national laboratories which would be of direct benefit to the semiconductor industry, and to find ways of implementing these projects. Numerous small projects were identified which would utilize unique capabilities of the national laboratories in advanced ion implantation, plasma processing (including electron cyclotron resonance plasmas), ion and cluster beam deposition, materials characterization, electronic packaging, and laser processing and deposition. Five large-scale candidate projects were identified in synchrotron x-ray lithography, silicon process integra-

tion, advanced materials processing science, process analysis and diagnostics, and ultra clean room engineering. The major obstacle to implementing these projects is the lack of appropriate funds to initiate and stimulate interactions between the national laboratories and the semiconductor industry. SEMATECH and the federal government are potential sources of seed funds for these projects. The Semiconductor Research Corporation is ideally suited to interface the semiconductor industry and the national laboratories for many of these interactions.

30650 **(DOE/ER/05015—T4) Mechanisms of gas permeation through polymer membranes: Final report for period December 1, 1986-March 15, 1987.** Stern, S.A. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). [1987]. Contract AC02-78ER05015. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88007322/JAW.

Objectives of this project are to investigate the mechanisms of transport of small molecules in and through nonporous polymer membranes, as well as the dependence of these mechanisms on polymer structure. Diffusion and permeability coefficients for Ar, CO/sub {2/}, CH/sub {4/}, C/sub {2/}H/sub {4/}, C/sub {3/}H/sub {8/}, CF/sub {4/}, SF/sub {6/}, and C/sub {2/}H/sub {2/}F/sub {2/} in polyethylene were determined in the temperature range from 5{degree} to 50{degree}C and at pressures up to 15-50 atm. Diffusion coefficients and solubility coefficients were determined from high-pressure absorption measurements. The coefficients were required for the determination of free-volume parameters, which were used to predict permeability coefficients by means of the free-volume model. The validity of an extension of the free-volume model of permeation to gas mixtures was tested. The "dual-mode" sorption model of gas transport and solution in glassy polymers has been extended to penetrantpolymer systems with concentration-dependent diffusion coefficients and to penetrants that exhibit a high solubility in glassy polymers. Two theoretical studies concerned with the dual-mode sorption model have been compeleted. A new "generalized" permeation model that incorporates both free-volume and dual-mode sorption concepts has been developed. Permeability, diffusion, and solubility coefficients for CH/sub {4/}, C/sub {2/}H/sub {6/}, and n-C/sub {4/}H/sub {10/} in poly(n-butyl methacrylate) (PnBMA) were determined at pressures up to 25 atm. and from {minus}14{degree} to 50{degree}C. 55 refs., 5 figs.

30651 **(DOE/ER/10597—1) The protonic β\{double prime\} aluminas: Preparation, stability, conductivity and structure: Final report, 1 March 1984-31 August 1986.** Farrington, G.C. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). 19 Mar 1988. Contract AC02-80ER10597. 28p.

The studies carried out under this contract investigated the preparation, thermal stability, conductivity, and structures of the various protonic beta aluminas. The following issues were addressed: (1) why does a mixed ammoniumhydronium composition form when sodium beta alumina undergoes ion exchange in ammonium nitrate and what determines the relative proportions of ammonium and hydronium ions in the structure; (2) what is the thermal stability of the compound; and (3) what is the conductivity of ammoniumhydronium beta alumina and how is it influenced by composition. Data demonstrate that composition, thermal stability, and ionic conductivity in ammoniumhydronium beta alumina are closely related. Proportions of ammonium and hydronium are variable and depend on the duration of the ion-exchange process. Eventually, however, a steady-state composition is achieved. This composition corresponds to a particular and rather elegant ordered arrangement of ammonium ions, hydronium ions, and vacancies in the structure. In addition and in contrast to previous work, we found that water and ammonia evolve from ammoniumhydronium beta alumina in discrete steps below 350{degree}C. Water is lost from the structure between 150 to 250{degree}C with an enthalpy of 10 kcalmole. The loss of ammonia occurs at 250 to 300{degree}C with an enthalpy of 19 kcalmole. Below 300{degree}C, the thermal decomposition of ammoniumhydronium beta alumina is reversible. The conductivity of single crystals of ammoniumhydronium beta alumina (steady-state composition) obeys an Arrhenius relationship below 200{degree}C with an activation energy of 0.26 eV (σ = 10/sup {minus/3}(Ω-cm)/sup {minus/1} at 25{degree}C). Thermal annealing at 280{degree}C causes the conductivity to fall into the range observed for samples of hydronium beta alumina. 14 refs., 10 figs., 1 tab.

30652 **(DOE/ER/13649—1) Mechanisms of gas permeation through polymer membranes: Progress report, March 16, 1987-January 15, 1988.** Stern, S.A.; Zhou, S.; Vaidyanathan, R. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). Jan 1988. Contract FG02-87ER13649. 9p.

Solution and diffusion coefficients are being determined for several gases in poly(n-butyl methacrylate) (PnBMA) and poly(n-propyl methacrylate) (PnPMA). It is concluded that the solubility and diffusivity of light gases in some polymers do not necessarily exhibit "dual-mode" sorption behavior below the glass transition temperature T/sub g/. E.g., no dual-mode sorption behavior was observed in PnBMA and PnPMA until the tempeature was lowered at least 30{degree}C below T/sub g/. This behavior depends on the "excess free volume" in the glassy polymer state and on the relative sizes of the penetrant gas molecules an of the mean free volume in the polymer. 16 refs., 1 fig.

30653 **(EGG-M—02187) Interfacial shear phenomena in graphite epoxy composites under impact loading using dynamic moire interferometry.** Deason, V.A.; Epstein, J.S.; Abdallah, M. (EG and G Idaho, Inc., Idaho Falls (USA); Hercules Aerospace Corp., Magna, UT (USA). Bacchus Works). 1987. Contract AC07-76ID01570. 7p. (CONF-8708213—4).

From SPIE international conference on photomechanics and speckle metrology; San Diego, CA, USA (17 Aug 1987).

As advanced structural materials (e.g., graphiteepoxy, metal matrix and ceramic matrix composites) or optical mirror substrate materials (e.g., beryllium and silicon carbide) are increasingly used in high performance systems, their ability to withstand environments that will cause loss of system survivability must be taken into account. The concept of survivability includes cases where the system is not destroyed, but is inoperable because of subtle effects on the system. These effects can be delamination from weak shock events, critical platform misalignment from large slew motions, or even mirror coating and substrate deformations of as little as a fraction of a micron from their specifications. All the effects listed above, in the system survivability realm, are very subtle and are due to transient deformations at a local or micromechanical level. This paper describes recent work to understand the transient mechanisms in composite interfaces that lead to impact delamination. The principal tool of investigation was dynamic moire interferometry coupled with continuum analysis. Results for two configurations under impact loading are presented. The first result shows dynamic interfacial shears in an AS43501-6 [090]/sub s/ composite. The second result shows similar effects in a $[0_2/90_2]$/sub s/ configuration of the same material. Similarities and dissimilarities will be discussed.

30654 **(IC—87/272) Thermal conductivity of $LiKSO_4$ near its high-temperature phase transition.** Okaz, A.M.; Mahmound, S.M.; Kassem, M.E. (International Centre for Theoretical Physics, Trieste (Italy); Alexandria Univ. (Egypt). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702676/JAW.

The thermal conductivity of $LiKSO_4$ ferroelastic crystals was measured along the three principal crystallographic axes in the vicinity of its high temperature phase transition at 705 K. The data showed an anomalous behaviour in the temperature dependence of the thermal conductivity in the transition region of width of about 25 degrees. The anomaly in the phonon contribution to the conductivity was referred to the freezing-in of either optic andor acoustic-modes of lattice vibrations in the near vicinity of the phase transition. The results are discussed in terms of scattering mechanisms of energy carriers. (author). 18 refs, 3 figs.

30655 (IC—87/336) New method for preparation of (Cd,Hg)Te thin films. Nguyen Van Khai; Ho Thi Phuong; Ta Hong Ngat; Nguyen Van Sung. (Academy of Sciences of Vietnam, Hanoi (Vietnam). Inst. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702727/JAW.

A new method for the preparation of (Cd,Hg)Te thin films has been described. This method is based on deposition of polycrystal Cd/sub z/Hg/sub 1-z/Te on a single crystal CdTe slice. The growth process is carried out in a strong temperature gradient of (50-100)Kcm during a period of (1-24) hours. The optical parameters of the grown films have been measured at the room temperature while the electrical parameters at liquid nitrogen temperature. (author). 14 refs, 4 figs.

30656 (IC—87/350) Thermostimulated conductivity in amorphous semiconductors with non-exponential density of localized states. Xu Zhengyi; Yang Huaguang; Gu Benyuan. (International Centre for Theoretical Physics, Trieste (Italy); Universita La Sapienza, Rome (Italy). Dipartimento di Fisica). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702737/JAW.

We calculate the thermostimulated conductivity (TSC) in amorphous semiconductors with non-exponential density of localized states (DOS) that has been obtained from the measurements of the field-effect by Weisfield et al. (Phil. Mag. B44(1981),83). The calculated results are compared with the case of exponential density of localized states. It turns out that the low-T-peak in the TSC becomes higher than the high-T-peak when the non-exponential DOS is rapidly increased in the high energy region. Except for this point, the profile of TSC in these two cases does not exhibit a substantial difference, but the results are quantitatively different. (author). 6 refs, 6 figs.

30657 (INPE—4475-PRE/1243) Multilayer thermal insulation tests. Mantelli, M.B.H. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Feb 1988. 21p. NTIS, PC A03/MF A01.

The main purpose of this work is to make experimental measurements of the effective emittance of Multilayer Thermal Insulation (MLI) constructed from Brazilian materials. The emissivities obtained are compared with theoretical and literary references. Heat is carefully calculated and a study of the resulting uncertainties made. The results obtained are encouraging and it is possible to produce and furnish the neceassary thermal blankets for Brazilian satellites. New materials are sought and additional MLI configurations will be tested.

30658 (IS-T—1348) Low-alumina portland cement from lime-soda sinter residue. Chesley, J.A. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 263p.

A byproduct for the Ames Lime-Soda Sinter Process for recovering alumina from power plant fly ash was investigated as a cement raw material. This investigation dealt with a determination of the best method to utilize the process residue from both a clinker quality and an economic perspective. The experimental work was divided into characterization of the sinter residue, laboratory burnability tests, physical testing of produced residue-cements, and a kinetic study of C_3S formation. Other important topics were considered such as the effect use of te sinter residue has on the energy requirements of a commercial cement kiln and on the economics of a combined lime-soda sinter, cement plant. (130 refs., 61 figs., 56 tabs.

30659 (LA-UR—88-589) Microlaminate composite structures by low pressure plasma spray deposition. Castro, R.G.; Stanek, P.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 12p. (CONF-880667—1).

From International powder metallurgy conference and exhibition; Orlando, FL, USA (5 Jun 1988).

The low pressure plasma spray (LPPS) process has been utilized in the development and fabrication of metal/metal, metal/carbide, and metal/oxide composite structures; including particulate dispersion and both continuous and discontinuous laminates. This report describes the LPPS process and the development of copper/tungsten microlaminate structures utilizing this processing method. Microstructures and mechanical properties of the Cu/W composites are compared to conventionally produced constituent material properties. 4 refs., 6 figs., 2 tabs.

30660 (LBL—24749) On the use of convergent beam electron diffraction for identification of antiphase boundaries in GaAs grown on Si. Liiental-Weber, Z.; Parechanian-Allen, L.; Washburn, J. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Materials Science and Mineral Engineering; Kopin Corp., Taunton, MA (USA)). Jan 1988. Contract AC03-76SF00098. 13p. (CONF-880174—1).

From Arizona State University winter workshop on electron diffraction and channeling at Kilovolt energies; Wickenburg, AZ, USA (11 Jan 1988).

This study shows that dynamical coupling effcts in CBED patterns can be unambiguously used to detect APBs. A high density of APBs can be present in GaAs grown by MOCVD (metalorganic chemical vapor depsoition) on Si (100) surfaces. APB formation is promoted by surface contamination and irregularities. APBs act as natural obstacles for the propagation of twins and stacking faults into the growing epitaxial layer. Faceting of APBs is probably connected with anisotropy of the interfacial energy of APBs. In most cases extended surface areas of APBs were observed to lie on the energetically favorable {110} planes. This observation is in agreement with earlier theoretical calculations. 17 refs, 6 figs.,

30661 (N—88-18627) Quantitative non-destructive evaluation of porous composite materials based on ultrasonic wave propagation. Semiannual progress report, 15 September 1987-14 March 1988. Miller, J.G. (Washington Univ., St. Louis, MO (USA)). Mar 1988. 29p. (NASA-CR—182544; NAS—1.26:182544). NTIS, PC A03/MF A01.

Two complementary ultrasonic techniques for characterizing porosity in fiber-reinforced composite laminates are evaluated. Five uniaxial graphite-fiber/epoxy-matrix composites having a range of 1 to 8 percent volume fraction of solid glass inclusions to model porosity were investigated. In one technique, signal loss was measured in transmission mode and slope of attenuation, obtained from the first order coefficient of a two-parameter polynomial fit about the center frequency of the useful bandwidth, was used as the ultrasonic parameter to characterize the porosity. The results of these transmission mode measurements displayed a good correlation between the volume fraction of porosity and the slope of attenuation. Integrated polar backscatter was used as a second ultrasonic parameter for the characterization of the porosity in these samples. A single transducer insonified the samples and measured the resulting backscatter at a polar angle of 30 deg with respect to the normal of the sample surface with the azimuthal angles centered at 0 deg with respect to the fiber orientation (i.e., along the fibers). Integrated polar backscatter also displayed good correlation with the volume fraction of porosity.

30662 (N—88-18646) Radiation and temperature effects on the time-dependent response of T300/934 graphite/epoxy. Interim report No. 69. Yancey, R.N.; Pindera, M.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Mar 1988. 171p. (NASA-CR—182603; NAS—1.26:182603; CCMS—88-02; VPI-E—88-5). NTIS, PC A08/MF A01.

A time-dependent characterization study was performed on T300/934 graphite/epoxy in a simulated space environment. Creep tests on irradiated and nonirradiated graphite/epoxy and bulk resin specimens were carried out at temperatures of 72 and 250 F. Irradiated specimens were exposed to dosages of penetrating electron radiation equal to 30 years exposure at GEO-synchronous orbit. Radiation was shown to have little effect on the creep response of both the composite and bulk resin specimens at 72 F while radiation had a significant effect at 250 F. A healing process was shown to be present in the irradiated specimens where broken bonds in the epoxy due to radiation recombined over time to form cross-links in the 934 resin structure. An analytical micromechanical model was also developed to predict the viscoelastic response of fiber reinforced composite materials. The model was shown to correlate well

with experimental results for linearly viscoelastic materials with relatively small creep strains.

30663 **(N—88-18901) Growth and characteristics of materials for tunable lasers in the near infrared spectral region. Semiannual progress report, 1 August 1987-31 January 1988.** Powell, R.C.; Martin, J.J. (Oklahoma State Univ., Stillwater (USA)). 1988. 20p. (NASA-CR—182501; NAS—1.26:182501). NTIS, PC A03/MF A01.

A method for growing crystals of $LiYF_4$ using an HF pretreatment and purification system is described. In addition, spectrum analyses were performed on eight crystals of type $LiNbO_3$:Mg,Cr,RE, which were grown in order to investigate the use of lithium niobate as a laser host material.

30664 **(N—88-19318) MCT crystal growth. Final report.** Baird, J.K. (Alabama Univ., Huntsville (USA)). Feb 1988. 23p. (NASA-CR—179297; NAS—1.26:179297). NTIS, PC A03/MF A01.

Convection and segregation in directional solidification and crystal growth by the Bridgman-Stockbarger technique are traditionally treated by assuming axisymmetric thermal condition on the ampoule wall. It is, however, difficult to achieve such a condition in an experimental setup. Any deviation from an axisymmetric temperature field on the wall of a vertical ampoule represents a horizontal temperature gradient. The horizontal density gradient that results from thermal expansion in the melt under this condition must lead on earth to some buoyance-driven convection, no matter what the axial (vertical) temperature distribution that is imposed on the melt. The magnitude of such convective flows for conditions representative of the MSFC mercury-cadmium-telluride (MCT) Bridgman setup is studied.

30665 **(N—88-19343) Feasibility studies of the growth of 3-5 compounds of boron by MOCVD. Final report.** Manasevit, H.M. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Mar 1988. 35p. (NASA-CR—181622; NAS—1.26:181622; SN—48565/51441). NTIS, PC A03/MF A01.

Boron-arsenic and boron-phosphorus films have been grown on Si sapphire and silicon-on-sapphire (SOS) by pyrolyzing Group 3 alkyls of boron, i.e., trimethylborane (TMB) and triethylborane (TEB), in the presence of AsH_3 and PH_3, respectively, in an H_2 atmosphere. No evidence for reaction between the alkyls and the hydrides on mixing at room temperature was found. However, the films were predominantly amorphous. The film growth rate was found to depend on the concentration of alkyl boron compound and was essentially constant when TEB and AsH_3 were pyrolyzed over the temperature range 550 C to 900 C. The films were found to contain mainly carbon impurities (the amount varying with growth temperature), some oxygen, and were highly stressed and bowed on Si substrates, with some crazing evident in thin (2 micron) B-P and thick (5 micron) B-As films. The carbon level was generally higher in films grown using TEB as the boron source. Films grown from PH_3 and TMB showed a higher carbon content than those grown from AsH_3 and TMB. Based on their B/As and B/P ratios, films with nominal compositions B/sub12-16 As2/ and B/sub1.1-1.3/ P were grown using TMB as the boron source.

30666 **(PB—88-861760/XAB) Photochromic polymers. January 1973-March 1988 (citations from the Rubber and Plastics Research Association data base). Report for January 1973-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 50p. NTIS PC N01/MF N01.

Supersedes PB—86-875853.

This bibliography contains citations concerning synthesis, properties, and reactions of photochromic polymers. Radiation and thermal effects on photochromic properties of polymers are discussed. The uses of photochromic materials in eyeglasses, spectacle lenses, photographic optics and laser optics are described. (This updated bibliography contains 87 citations, 10 of which are new entries to the previous edition.)

30667 **(PB—88-861927/XAB) Stained and colored glasses. January 1975-March 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 79p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the properties of glass color centers, and the effects of chemical composition and fabrication techniques on the color of glass. The effects of radiation, laser beams, and electron beams on glass color centers is described. Melting conditions, photosensitivity, and glaze formation affecting glass color are also examined. (Contains 147 citations fully indexed and including a title list.)

30668 **(PB—88-862305/XAB) Ultraviolet curing of polymer coatings. January 1980-April 1988 (Citations from World Surface Coatings Abstracts). Report for January 1980-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 114p. NTIS PC N01/MF N01.

Supersedes PB—87-857975.

This bibliography contains citations concerning methods, evaluations, and equipment for the ultraviolet curing of polymer coatings. Topics include curable coating compositions, protective and decorative coatings, optical-fiber coatings, curing photoinitiators, properties and stabilization of cured coatings, and coating binders. Ultraviolet-curable polymer materials for use in the furniture, food, electronics, and automotive industries are considered. Citations concerning printing inks and polyurethane curing are excluded and are available as two separate bibliographies. (This updated bibliography contains 292 citations, 62 of which are new entries to the previous edition.)

30669 **(PB—88-862560/XAB) High-temperature, high-wear-resistant solid lubricants. April 1983-April 1988 (Citations from Fluidex data base). Report for April 1983-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 103p. NTIS PC N01/MF N01.

Supersedes PB—87-858692.

This bibliography contains citations concerning solid lubricants for high wear and high-temperature-resistant surfaces. Emphasis is on molybdenum disulfide; however, gold-molybdenum alloys and polysiloxanes are also discussed. Methods for depositing thin film solid lubricants, including sputtering and electrodeposition, are presented. The corrosion properties of the solid lubricant-metal interface are also included. (This updated bibliography contains 288 citations, 97 of which are new entries to the previous edition.)

30670 **(PB—88-862586/XAB) Ablation and ablative materials: aerospace applications and materials studies. January 1977-April 1988 (Citations from the NTIS data base). Report for January 1977-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 176p. NTIS PC N01/MF N01.

Supersedes PB—87-856944.

This bibliography contains citations concerning ablation processes and ablative materials pertaining to aerodynamic surfaces and propulsion structures. Material ablation in combustion processes, heat-shield and reentry structures, and rocket nozzles is discussed. Composites, ceramics, and graphite compounds are among the specific materials considered. Computer simulations of ablation processes are also included. Citations pertaining specifically to ablation processes in plasma physics and nuclear fusion studies are excluded. (This updated bibliography contains 329 citations, 10 of which are new entries to the previous edition.)

30671 **(PB—88-862909/XAB) Laser materials: radiation damage. January 1970-April 1988 (Citations from the NTIS data base). Report for January 1970-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 154p. NTIS PC N01/MF N01.

Supersedes PB—87-859773.

This bibliography contains citations concerning laser beam damage to laser materials, including optical glass, mirrors, optical coatings, dielectrics, semiconductors, and alkali metal halides. The

damage mechanisms are explored for various types of laser materials. Comparisons are made between variations in fabrication and preparation of the materials and the resulting degradation or damage to the materials. (This updated bibliography contains 313 citations, 10 of which are new entries to the previous edition.)

30672 **(PNL-SA—15049) Molecular characterization of structure and bonding in thin film materials.** Exarhos, G.J. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 17p. (CONF-880110—23). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006811/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The application of Raman spectroscopy to the analysis of dielectric films with respect to phase composition and homogeneity has been reported during the past several years. Interfacial strain at the film-substrate interface, which influences chemical bonding, also perturbs the vibrational spectrum and can be quantified from measured frequency shifts. Recent work has shown that this inelastic light scattering technique can be used as an in situ probe of chemical bonding during film deposition and under conditions where the film undergoes catastrophic degradation caused by high energy particle or high pulse energy laser irradiation. examples are presented in this review which demosntrate the utility of this technique for understanding molecular structural changes which result during sol-gel or plasma processing of films. Real-time measurements of thin films subjected to high temperature and pressure environments also emphasized. 38 refs., 11 figs.

30673 **(RAL—88-016) Anisotropy in the atomic momentum distribution of pyrolytic graphite.** Paoli, M.P.; Holt, R.S. (Rutherford Appleton Lab., Chilton (UK)). Feb 1988. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753100/JAW.

Deep inelastic neutron scattering on the pulsed source ISIS at the Rutherford Appleton Laboratory has been used to determine the mean atomic kinetic energy in polycrystalline and pyrolytic graphite. An analysis of the recoil distribution widths shows a significant anisotropy in the atomic momentum distribution measured parallel and perpendicular to the hexagonal layers. Comparison between the observed mean kinetic energies and those derived from a phonon density of states model are in agreement perpendicular to the hexagonal layers but at variance parallel to the layers. A small asymmetry in the recoil line shape has also been observed and is attributed to the influence of final state corrections to the Impulse Approximation.

30674 **(SAND—87-2509C) Diffusion of homopolymers into nonequilibrum diblock copolymer structures.** Green, P.F.; Russell, T.P.; Jerome, R. (Sandia National Labs., Albuquerque, NM (USA); IBM Almaden Research Center, San Jose, CA (USA); Liege Univ. (Belgium)). 1988. Contract AC04-76DP00789. 9p. (CONF-880660—1).

From International symposium on new trends in physics and physical chemistry of polymers; Toronto, Canada (5 Jun 1988).

Of concern in the present report is the diffusion of homopolmer chains into microphase separated symmetric diblock copolymer hosts. Forward recoil spectrometry was used to study the diffusion of deuterated PS (d-PS) and of d-PMMA into two symmetric diblock copolymer hosts comprised of polystyrene (PS) and polymethylmethacrylate (PMMA). The molecular weight and temperature dependence of diffusion are reported. 4 figs., 13 refs.

30675 **(SAND—87-2559C) Sol-gel derived thin films.** Brinker, C.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-8711168—1). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007426/JAW.

From American Ceramic Society meeting; Cocoa Beach, FL, USA (17 Nov 1987).

The microstructure of sol-gel-derived thin films can be manipulated by control of the precursor strtucture prior to deposition and the relative rates of condensation and evaporation during deposition. In general weakly branched precursors deposited under conditions in which the condensation rate is low result in very compact, microporous films. Increased branching of the precursors and/or increased condensation rates result in reduced film densities. 12 refs., 4 figs.

30676 **(SAND—87-2574C) Sol-gel kinetics: ^{29}Si NMR [nuclear magnetic resonance] and a statistical reaction model.** Assink, R.A.; Kay, B.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-880408—11).

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The early time behavior of an acid catlayzed $Si(OCH_3)_4$ (TMOS) sol-gel was studied by high resolution ^{29}Si nuclear magnetic resonance (NMR). Both the water producing and the alcohol producing condensation reactions were found to contribute significantly to the overall condensation rate. A general theoretical kinetic formalism which specifically treats the temporal evolution of the various chemical function groups about a specific slilcon atom was developed. The experimentally observed functional group distribution was in agreement with the distribution predicted by a simplified statistical reaction model. The mathematical framework for the study of chemical speciation at the next-to-nearest functional group level was developed. This framework was used to assign several fine structure resonances, and to show that the formation of various dimeric species is also largely statistical in nature. 17 refs., 6 figs.

30677 **(SAND—88-0033C) Metastability in SiGe/Si strained-layer structures.** Dodson, B.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880408—5). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007603/JAW.

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

The physics governing growth and stability properties in SiGe/Si strained-layer structures is reviewed. The role of metastability in crystal growth is outlined. Experimental data on stability limits and rates of strain relaxation are examined. We conclude that essentially all observations on relaxation of semiconductor strained-layer structures can be explained by standard models of plastic deformation adapted to the special conditions controlling dislocation dynamics in these structures. 29 refs., 5 figs.

30678 **(SAND—88-0318C) Electrophoretic coatings: Part 1, Sandia applications.** Sharp, D.J.; Panitz, J.K.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880383—1).

From AT and T Task Group V meeting; Albuquerque, NM, USA (22 Mar 1988).

Electrophoretic (electrocoating) technology provides capabilities for deposition of a broad range of dielectric materials. Many modern electrophoretic coating resins, including the resin we are working with are designed to deposit at the anode. The resins are commonly synthesized by maleinizing the organic backbone to introduce carboxylate groups (RCOO/sup minus/). These materials may then be electrochemically deposited as colloidal species suspended in a liquid. Colloidal particles which do not normally deposit electrophoretially by themselves may be adsorbed onto polymers or other electrophoretically active charged species, ionic detergents for example, thereby providing a vehicle for transport and deposition. With the proper choice of these intermediaries which may be either allowed to remain in the deposit or removed by oxidative firing, etc., a broad range of material become coating candidates. We also report on variations in electrocoating technology which permit deposition of composite high thermal conductivity dielectric coatings for photovoltaic concentrator arrays, adhesive-dielectric coatings, aluminum oxidestyrene-acrylate dielectric films for capacitor applications, submicron-thick, free-standing, polymer films, fluorocarbon-binder tribological coatings, and radiation hardening coatings. 10 figs.

30679 **(SAND—88-0612C) On the bending response of Kevlar 49/epoxy beams and rings.** Reedy, E.D. Jr. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 15p. (CONF-880572—1).

From ABAQUS user's meeting; Newport, RI, USA (31 May 1988).

Kevlar 49/epoxy laminates often exhibit substantial material nonlinearity when subjected to bending. This is a consequence of the yeild-like behavior of a Kevlar 49/epoxy lamina in fiber-directed compression. In this paper, analyses that utilize a simple idealization of compressive yielding are described and calculated results for Kevlar 49 reinforced beams and rings are compared with available data. First, results of a finite element analysis of a thin, unidirectionally reinforced ring subjected to diametral compression are presented. This analysis uses beam elements that incorporate linear tensile and elastic-perfectly plastic compressive behavior. Then a method used to analyze quasi-isotropic beams tested in four-point bending is discussed. This finite element analysis uses a layered shell element with a lamina constitutive model that permits elastic-perfectly plastic response to fiber-directed compression, but otherwise assumes linear elastic behavior. Comparison of calculated and experimental results corroborate the ability of analyses using a simple compressive yield model to account for much of the observed flexural nonlinearity in Kevlar 49/epoxy beams and rings. 6 figs.

30680 **(UCRL—98168) Laser fluorescence spectroscopy of zinc neutrals originating from laser-irradiated and ion-bombarded zinc sulfide and zinc surfaces.** Arlinghaus, H.F.; Calaway, W.F.; Young, C.E.; Pellin, M.J.; Gruen, D.M.; Chase, L.L. (Argonne National Lab., IL (USA); Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48;W-31109-ENG-38. 12p. (CONF-8710165—13).

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

Time-of-flight (TOF) measurements, employing high-resolution laser-induced fluorescence spectroscopy (LFS) as a probe, have been used to measure the yield and velocity distribution of Zn atoms ejected from a ZnS single crystal under irradiation by 308 nm photons. By comparison with the known ion sputtering yield for pure zinc, the absolute yield was determined to be 10^{10} atom-spulse at a laser fluence of 30 mJcm^{2}. The velocity distribution of the Zn atoms could be fitted by a Maxwell-Boltzmann distribution, having a characteristic temperature of 2360{degree}K. In addition, Doppler-shift techniques have been combined with TOF measurements in order to separate prompt from delayed emission of ablated atoms, as well as to probe possible molecular or cluster fragmentation. The results obtained suggest the possibility of molecular or cluster emission from ZnS. 17 refs., 7 figs.

30681 **Dislocation loops and precipitates associated with excess arsenic in GaAs.** Lee, B.; Gronsky, R.; Bourret, E.D. (Center for Advanced Materials, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **64**: No. 1, 114-118(1 Jul 1988).

Dislocation loops and precipitates in an arsenic-rich GaAs crystal have been studied by transmission electron microscopy to investigate their formation mechanism and establish their relationship to point defects. The precipitates are identified to be hexagonal arsenic phases having a simple orientation relationship with the GaAs matrix. Detailed analyses of the loops indicate that they are composed of two separate defects lying on (111) planes: a faulted loop and a perfect loop. It is proposed that the loops are formed by condensation of excess arsenic interstitials followed by clustering of excess Ga vacancies and subsequent generation and movement of Shockley partial dislocation(s). The faulted loop is interpreted as an hcp arrangement of arsenic atoms. This model supports the hypothesis that arsenic interstitials and Ga vacancies coexist in GaAs at high temperatures although arsenic interstitials initiate the formation of arsenic-related dislocation loops. Implications concerning the formation process of the EL2 deep-level defect are also discussed.

30682 **Anisotropy of thermal expansion of GaAs on Si(001).** Lucas, N.; Zabel, H.; Morkoc, H.; Unlu, H. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana—Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Applied Physics Letters;* **52**: No. 25, 2117-2119(20 Jun 1988).

We have measured the thermal expansion between 20 and 450 °C of epitaxially grown GaAs thin films on Si(001) as well as of the Si substrate by means of high-resolution x-ray scattering. Our results show that the thermal expansion of GaAs in the direction parallel to the film plane follows the thermal expansion of the silicon substrate and is therefore smaller than in bulk GaAs. Furthermore, the thermal expansion perpendicular to the film plane (parallel to the growth direction) exceeds the bulk GaAs value by the Poisson contribution as a result of the in-plane constraint. The thermal expansion coefficients for GaAs films on Si(001) substrates in the directions parallel and perpendicular to the film plane are α/sup T//sub parallel/(GaAs) = 3.46 x 10^{-6}K and α/sup T//sub perpendicular/(GaAs) = 8.91 x 10^{-6}K, respectively.

30683 **Structure and electrical properties of TiN/GaAs Schottky contacts.** Ding, J.; Liliental-Weber, Z.; Weber, E.R.; Washburn, J.; Fourkas, R.M.; Cheung, N.W. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **52**: No. 25, 2160-2162(20 Jun 1988).

The interface structure and morphology of TiN/GaAs contacts before and after annealing at 500, 700, and 850 °C have been investigated by transmission electron microscopy. Results reveal that pocket-like protrusions are formed beneath the interface after annealing at 500 °C. These pockets increased in number and maximum size with increased annealing temperature. Outdiffusion of Ga and/or As along high angle grain boundaries between columnar structure of the as-deposited TiN thin film has been proposed as being responsible for the pocket formation. The changes of electrical characteristics of these materials after annealing have been related to the formation of these pockets.

30684 **Electronic structure of ultrathin (GaAs)/sub n/(AlAs)/sub n/ [001] superlattices and the Ga/sub 0.5/Al/sub 0.5/As alloy.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **63**: No. 12, 5794-5804(15 Jun 1988). Contract AC02-77CH00178.

Using self-consistent electronic structure calculations we contrast the energy levels of the ultrathin (GaAs)/sub n/(AlAs)/sub n/ [001] superlattices (n = 1,2) with those of the disordered Ga/sub 0.5/Al/sub 0.5/As alloy and a long period ($n\rightarrow\infty$) superlattice. Conventional Kronig—Penney and effective mass models suggest that, because of the relatively light electron effective masses and small barrier heights, only delocalized superlattice conduction states would exist in the n = 1 limit. We find a number of such conventional "averaging states" (delocalized on both sublattices). In addition, we also find states localized on a single sublattice. For small n's, the latter are divided into two classes: (i) "repelling states" (distinct alloy states which fold in the superlattice into states of identical symmetry, which, in turn, repel each other and tend to localize), and (ii) "segregating states" (a pair of localized states Psi/sup α/ and Psi/sup β/, where symmetry compels Psi/sup α/ to have a vanishing angular momentum component l on a subset α of unit cell atoms, whereas the complementary state Psi/sup β/ is localized on the other atoms β. These states are split by the potential difference V/sup β//sub l/ -V/sup α//sub l/). We analyze new luminescence, reflectance, and Raman data in light of our theoretical model. Studies of the II-VI superlattices $(CdTe)_1(HgTe)_1$ shows similar behavior.

30685 **Ground-state and finite-temperature energetics and topologies of germanium microclusters.** Antonio, G.A.; Feuston, B.P.; Kalia, R.K.; Vashishta, P. (Departamento de Fisica e Ciencia dos Materiais, Instituto de Fisica e Quimica de Sa-tildeo Carlos, Universidade de Sa-tildeo Paulo 13560-Sa-tildeo Carlos, SP, Brasil and Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 12, 7671-7686(15 Jun 1988). Contract W-31-109-ENG-38.

We have investigated the ground-state and finite-temperature properties of Ge microclusters (N = 2 to 14) using molecular dynamics (MD) simulation along with the method of steepest-descent quench (SDQ). The interaction potential adopted is the three-body

Stillinger—Weber potential as modified by Ding and Andersen for amorphous Ge. Our results indicate that the experimentally observed greater stability of certain cluster sizes can be explained by the topology and energetics of the clusters at finite temperature rather than by the binding energies of the ground-state structures.

30686 **Local-density calculations of the magnetic and paramagnetic phases of TmSe and TmTe.** Norman, M.R.; Jansen, H.J.F. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 10050-10054(15 Jun 1988).

Results of local-density calculations are reported for both the paramagnetic and antiferromagnetic phases of mixed-valence TmSe. In the magnetic calculation, orbital moment effects are included self-consistently. Comparison of specific-heat data to the band density of states of the paramagnetic phase indicates a mass renormalization factor of 4.6, similar to what is seen in mixed-valence $CeSn_3$. The moment-polarized calculation yields a total moment of 4.1μ/sub B/, and an 86% gapping of the Fermi surface through the magnetic phase transition. The moment value is not consistent with the observed low-field-phase value of 1.7μ/sub B/, but is consistent with the one in the higher-field metamagnetic phase. We also show evidence that the prediction of incomplete gapping of the Fermi surface is not inconsistent with specific-heat and resistivity data. Finally, we find that the insulating gap seen in TmTe can only be reproduced in a calculation where the f electrons are treated as core states.

30687 **Band-gap tailoring of ZnO by means of heavy Al doping.** Sernelius, B.E.; Berggren, K.; Jin, Z.; Hamberg, I.; Granqvist, C.G. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 10244-10248(15 Jun 1988).

Films of ZnO:Al were produced by weakly reactive dual-target magnetron sputtering. Optical band gaps, evaluated from spectrophotometric data, were widened in proportion to the Al doping. The widening could be quantitatively reconciled with an effective-mass model for n-doped semiconductors, provided the polar character of ZnO was accounted for.

30688 **Electromodulation of the electronic structure and optical properties of [111]-growth-axis superlattices.** Mailhiot, C.; Smith, D.L. (Xerox Webster Research Center, 800 Phillips Road, 0114-41D, Webster, New York 14580). *Physical Review [Section] B: Condensed Matter;* **37**: No. 17, 10415-10418(15 Jun 1988).

We show that large, linear electrooptic coefficients are expected in strained-layer superlattices grown along the [111] axis. The linear electrooptic effects in these superlattices are due to the large, piezoelectrically generated internal electric fields which occur in them. Such linear electrooptic coefficients are not expected in lattice matched superlattices or superlattices grown along [100].

30689 **Linear electro-optic effect in β-BaB_2O_4.** Ebbers, C.A. (Department of Applied Science, Lawrence Livermore National Laboratory, University of California at Davis, P.O. Box 5508, L-490, Livermore, California 94550). *Applied Physics Letters;* **52**: No. 23, 1948-1949(6 Jun 1988).

The linear electro-optic (EO) coefficients of beta-barium borate (β-BaB_2O_4) have been measured. The clamped and unclamped values of r/sub y//sub y//sub y/ and r/sub c/ are chemical bondr/sup T//sub y//sub y//sub y/chemical bond = 2.5 pmV, chemical bondr/sup T//sub c/chemical bond = 0.17 pmV, chemical bondr/sup S//sub y//sub y//sub y/chemical bond = 0.24r/sup S//sub x//sub y//sub z/ (KDP), and chemical bondr/sup S//sub c/chemical bond = 0.013r/sup S//sub x//sub y//sub z/ (KDP). The magnitude of the EO coefficient is due mainly to the electronic nonlinearity.

30690 **Long-lived resonance states in n-doped AlGaAs.** Hjalmarson, H.P.; Drummond, T.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **60**: No. 23, 2410-2413(6 Jun 1988).

The electronic properties of localized resonance states in III-V compound semiconductors are analyzed. In general, resonance states recombine rapidly with the band states. However, a new class of resonance states is found to be long lived if their coupling to the lattice is sufficiently large. The recombination of these states with band states is thermally activated which leads to extremely long lifetimes at low temperatures. Such states can explain recent experiments suggesting long-lived resonance states associated with persistent photoconductivity and "DX centers" in n-doped Al_1\/sub x/Ga/sub x/As for $x<0.2$.

30691 **Mechanism for chemical-vapor deposition of tungsten on silicon from tungsten hexafluoride.** Yarmoff, J.A.; McFeely, F.R. (IBM T. J. Watson Research Center, P. O. Box 218, Yorktown Heights, New York 10598). *Journal of Applied Physics;* **63**: No. 11, 5213-5219(1 Jun 1988).

The mechanism for the growth of tungsten films on silicon substrates with the use of low-pressure chemical-vapor deposition from WF_6 was studied with soft-x-ray photoemission by growing films in situ. The dissociative chemisorption of WF_6 on Si(111) was found to be complete, even at room temperature. The reaction is self-poisoning at room temperature, however, as the fluorine liberated from WF_6 ties up the active Si sites responsible for the dissociation. The mechanism for continued growth of tungsten films at elevated temperature was determined to proceed via Si diffusion through the layer towards the surface. Post-fluorination of these films via XeF_2 was employed as a means for illustrating their morphology.

30692 **Raman scattering in GaP_1\/sub x/Sb/sub x/.** Cherng, Y.T.; Jou, M.J.; Jen, H.R.; Stringfellow, G.B. (Department of Materials Science and Engineering, University of Utah, Salt Lake City, Utah 84102). *Journal of Applied Physics;* **63**: No. 11, 5444-5446(1 Jun 1988).

The lattice-dynamic properties of GaP_1\/sub x/Sb/sub x/ have been investigated for the first time by using Raman scattering measurements. This alloy, which has a large miscibility gap, has been grown by organometallic vapor phase epitaxy. The first-order Raman spectra for the ternary samples show two mode behavior over the whole composition range. The composition dependence of the intensity and energy shift of each mode is reported. The broadening and asymmetry of the GaP longitudinal-optical modes are analyzed in terms of alloy disorder effects.

30693 **Dislocation density reduction through annihilation in lattice-mismatched semiconductors grown by molecular-beam epitaxy.** Sheldon, P.; Jones, K.M.; Al-Jassim, M.M.; Yacobi, B.G. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Applied Physics;* **63**: No. 11, 5609-5611(1 Jun 1988). Contract AC02-83CH10093.

Epitaxial InAsGaAs, GaAsGeSi, GaAsInP, and InAsInP heterostructures are grown by molecular-beam epitaxy. Transmission electron microscopy studies reveal that, for these heteroepitaxial systems, the threading dislocation density is inversely proportional to the epilayer thickness. At a given thickness, the threading dislocation density is relatively insensitive to lattice mismatch ($3.2\% <$ chemical bondΔachemical bond$a < 7.2\%$), to differences in thermal expansion coefficients ($6.9 \times 10^{-7} <$ chemical bond$\Delta\alpha$chemical bond$< 3.4 \times 10^{-6}$ K^{-1}), to interfacial surface chemistry, and to epilayer morphology. Epitaxial layers incorporating growth interrupts produce lower overall defect densities, yet they maintain defect-reduction profiles similar to those observed in layers without the growth interrupt.

30694 **Liquid structuring at solid interfaces as probed by direct force measurements: The transition from simple to complex liquids and polymer fluids.** Israelachvili, J.N.; Kott, S.J. (Department of Chemical and Nuclear Engineering, and Materials Department, University of California, Santa Barbara, California 93106). *Journal of Chemical Physics;* **88**: No. 11, 7162-7166(1 Jun 1988).

Results are presented of the equilibrium forces between two molecularly smooth surfaces immersed in pure monodisperse polymer liquids or "melts": liquid polybutadienes of molecular weights $\sim$1000 and $\sim$3500, corresponding to $n_m \approx 20$ and $n_m \approx 65$ segments (monomer units) per molecule, respectively. The aims were (i) to establish the minimum segment number when a flexible chain mole-

cule begins to interact like "a polymer," (ii) to investigate the nature of the transition from simple liquid-like behavior (as occurs with short-chained alkanes) to that characteristic of long-chained polymers, and (iii) to compare the forces in polymer melts with those where dissolved polymers are adsorbed from solution, and thereby ascertain whether there are any fundamental differences between these two types of interactions. The results show that, unlike liquid alkanes (up to hexadecane, n = 16), liquid polybutadienes with n>20 already exhibit "polymer-like" interactions. There is also a striking similarity between the forces measured in pure polymer melts with those previously measured when polymers are adsorbed to saturation onto surfaces from good solvents; viz., a purely monotonic repulsive force law extending out to a few radii of gyration between the surfaces. It is concluded that the transition from the simple liquid-like ordering of spherical or short-chained molecules at surfaces to that characteristic of long-chained polymers is essentially a transition from a quasiordered layering of segments parallel to surfaces, extending a few segment diameters, to a more random disordered state farther out describable by mean field and scaling theories.

30695 **Theory for the chi parameter of polymer blends: Effect of attractive interactions.** Curro, J.G.; Schweizer, K.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **88**: No. 11, 7242-7243(1 Jun 1988). Contract AC04-76DP00789.

Using an integral equation theory for polymer blends, we have calculated the effective chi parameter for a binary blend of Gaussian polymers interacting with identical hard core repulsive and dissimiliar attractive interactions between chain segments. Our results predict a parabolic composition dependence for chi in qualitative accordance with recent neutron scattering experiments and Monte Carlo simulations. We also find that the attractive interactions induce structural correlations which tend to significantly reduce chi and thus stabilize the miscible mixture.

30696 **Photoreflectance, absorption, and nuclear resonance reaction studies of Al/sub x/Ga_1√/sub x/ As grown by molecular-beam epitaxy.** Huang, D.; Ji, G.; Reddy, U.K.; Morkoc, H.; Xiong, F.; Tombrello, T.A. (Coordinated Science Laboratory, University of Illinois at Urbana-Champaign, 1101 West Springfield Avenue, Urbana, Illinois 61801). *Journal of Applied Physics;* **63**: No. 11, 5447-5453(1 Jun 1988).

The photoreflectance (PR) spectra of bulk Al/sub x/Ga_1√/ sub x/As alloys with x≦0.45 were studied. The observed line shapes from different samples suggest that the PR technique is very sensitive to the material quality, surface condition, and the background impurities. The energy gap derived from the PR spectra compared well to that obtained from the absorption spectra. The relationship between the energy gap and the Al mole fraction value x was established through the nuclear resonance reaction analysis. The electric field near the surface was calculated from the periodicity of Franz—Keldysh oscillations observed in many of the samples. From our analysis, we believe that the number of oscillations shown in PR spectra corresponds to sample quality, in general. We also believe that the low-field-like line shape is mainly caused by the fluctuation of Al distribution along the growth direction. An additional feature related to the impurity transition was also observed in the spectra.

30697 **Photon-controlled fabrication of amorphous superlattice structures using ArF (193 nm) excimer laser photolysis.** Lowndes, D.H.; Geohegan, D.B.; Eres, D.; Pennycook, S.J.; Mashburn, D.N.; Jellison G.E. Jr. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6056). *Applied Physics Letters;* **52**: No. 22, 1868-1870(30 May 1988).

Pulsed ArF (193 nm) excimer laser photolysis of disilane, germane, and disilane-ammonia mixtures has been used to deposit amorphous superlattices containing silicon, germanium, and silicon nitride layers. Transmission electron microscope cross-section views demonstrate that structures having thin (5—25 nm) layers and sharp interlayer boundaries can be deposited at substrate temperatures below the pyrolytic threshold, entirely under laser photolytic control.

30698 **Coherent precipitation of silicon nitride in silicon.** Kaushik, V.S.; Datye, A.K.; Kendall, D.L.; Martinez-Tovar, B.; Myers, D.R. (Department of Chemical and Nuclear Engineering, University of New Mexico, Albuquerque, New Mexico 87131). *Applied Physics Letters;* **52**: No. 21, 1782-1784(23 May 1988).

Coherent growth of α-Si_3N_4 precipitates is observed in a silicon matrix after implantation of 150 keV N^+ at a dose of 1 x 10^{18}/cm^2 into (110) silicon. The near-channeling conditions lead to a band of discrete precipitates, 0.5 μm below the continuous, polycrystalline buried nitride layer. No misfit dislocations or strain contrast were observed in the silicon matrix despite a 10% lattice mismatch along the Si_3N_4 [0001] direction and a 1% mismatch along directions perpendicular to [0001]. The mismatch appears to be accommodated entirely within the precipitate by a mosaic structure consisting of single-crystal subunits, coherent with Si at the Si_3N_4 (0001)/Si{111} interface, but incoherent perpendicular to these planes.

30699 **Time-resolved x-ray study of Ge during pulsed laser melting.** Tischler, J.Z.; Larson, B.C.; Mills, D.M. (Solid State Division, Oak Ridge National Lab, Oak Ridge, Tennessee 37831-6024). *Applied Physics Letters;* **52**: No. 21, 1785-1787(23 May 1988). Contract AC05-84OR21400.

Nanosecond resolution time-resolved x-ray diffraction has been used to make the first measurements of the liquid-solid interface overheating and undercooling in germanium. The results show an orientation-dependent undercooling for growth on (111) and (001) faces. For both the (111) and (001) faces the velocity versus temperature interface response function has a slope of ~5 K/(m/s), except for undercooling on the (111) face where the slope is 20 K/(m/s).

30700 **Semiclassical formalism of optical absorption and breathers in polyacetylene.** Horovitz, B.; Bishop, A.R.; Phillpot, S.R. (Theoretical Division and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **60**: No. 21, 2210-2213(23 May 1988).

A formalism for the optical absorption in a coupled electron-ion system is developed. The formalism assumes an initial trajectory with frequency much lower than electronic energy scales, and a short memory condition, i.e., the excited-state trajectories diverge away from the initial trajectory within one period. The result shows nonadiabatic features such as level broadening, sidebands, and tails in nonclassical regimes. We apply the formalism to breather modes in polyacetylene and show that they can account for the intragap absorption tail and for the observed photoinduced absorption at 1.35 eV.

30701 **Observation of gas-phase Si atoms in the chemical vapor deposition of silicon from dichlorosilane.** Ho, P.; Breiland, W.G. (Sandia National Laboratories, Albuquerque, New Mexico 87185-5800). *Journal of Applied Physics;* **63**: No. 10, 5184-5186(15 May 1988). Contract AC04-76DP00789.

Gas-phase silicon atoms have been observed during the chemical vapor deposition (CVD) of silicon from SiH_2Cl_2 in helium at 625 Torr total pressure. The silicon atoms are products of gas-phase reactions as evidenced by a maximum in the relative density profile. Under identical deposition conditions, SiH_2Cl_2 CVD yields Si atom densities that are one to two orders of magnitude smaller than those observed during SiH_4 CVD.

30702 **Identification of dark-line defects in AlGaAs/InGaAs/GaAs heterostructures.** Fitzgerald, E.A.; Ashizawa, Y.; Eastman, L.F.; Ast, D.G. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Journal of Applied Physics;* **63**: No. 10, 4925-4928(15 May 1988).

We have investigated the correlation between the structure of and the nonradiative recombination at defects in AlGaAs/InGaAs/GaAs heterostructures using scanning cathodoluminescence (CL) and transmission electron microscopy (TEM). It is shown that the dark-line defects seen in scanning CL images do not always correspond to individual misfit dislocations even for rela-

tively low mismatched epilayers. CL and TEM images from the same area reveal that there are structures which do correlate to the dark lines seen in CL. The density of dislocations at the interface determines which structure dominates the CL image. At very low misfit, the dark lines correspond to single 60° or edge dislocations, whereas at higher misfit the dark lines correspond to groups of dislocations. Contrary to previous studies in GaAlAsP/GaAlAs semiconductor heterostructures [J. Microsc. 118, 255 (1980)], we have found that edge dislocations at AlGaAs/InGaAs and InGaAs/GaAs interfaces are higher nonradiative recombination sites than 60° dislocations. TEM micrographs show that edge dislocations form more readily along one <110> direction, possibly explaining differences in residual elastic strain measurements along different <110> directions.

30703 **Minority-carrier lifetime in n-Al/sub 0.38/Ga/sub 0.62/As.** Ahrenkiel, R.K.; Dunlavy, D.J.; Loo, R.Y.; Kamath, G.S. (Solar Energy Research Institute, Golden, Colorado 80501). *Journal of Applied Physics;* **63**: No. 10, 5174-5176(15 May 1988).

The minority-carrier lifetime in n-Al/sub 0.38/Ga/sub 0.62/As has been investigated by laser-induced photoluminescence. A variety of device structures were used to reduce interface recombination effects, including double heterostructures. Bulk lifetimes of about 18 ns were seen at doping levels of 1 x 10^{16} cm^{-3} or less. These data suggest that minority-carrier devices are feasible in high aluminum AlGaAs, contrary to the suggestion of earlier work.

30704 **Role of metal d states in II-VI semiconductors.** Wei, S.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **37**: No. 15, 8958-8981(15 May 1988). Contract AC02-77CH00178.

All-electron band-structure calculations and photoemission experiments on II-VI semiconductors both exhibit a metal d subband inside the main valence band. It has nevertheless been customary in pseudopotential and tight-binding approaches to neglect the metal d band by choosing Hamiltonian parameters which place this band inside the chemically inert atomic cores. Using all-electron self-consistent electronic-structure techniques (which treat the outermost d electrons on the same footing as other valence electrons) and comparing the results to those obtained by methods which remove the d band from the valence spectrum, we study their effects on valence properties. For II-VI semiconductors we find that p-d repulsion and hybridization (i) lower the band gaps, (ii) reduce the cohesive energy, (iii) increase the equilibrium lattice parameters, (iv) reduce the spin-orbit splitting, (v) alter the sign of the crystal-field splitting, (vi) increase the valence-band offset between common-anion II-VI semiconductors, and (vii) modify the charge distributions of various II-VI systems and their alloys. p-d repulsion is also shown to be responsible for the occurrence of deep Cu acceptor levels in II-VI semiconductors (compared with shallow acceptors of Zn in III-V), for the anomalously small band gaps in chalcopyrites, and for the negative exchange splitting in ferromagnetic MnTe.

30705 **Stoichiometry and surface reconstruction: An ab initio study of GaAs(100) surfaces.** Qian, G.; Martin, R.M.; Chadi, D.J. (Xerox Palo Alto Research Center, Palo Alto, California 94304). *Physical Review Letters;* **60**: No. 19, 1962-1965(9 May 1988).

Ga- and As-terminated GaAs(100) surfaces are studied through first-principles density-functional pseudopotential calculations of the energies of surfaces with different stoichiometries and reconstructions. We predict structural transitions as a function of Ga and As chemical potentials within an experimentally accessible range which is shown to be fixed by the bulk energies of Ga, As, and GaAs. The bulk energies are determined accurately by the ab initio calculations. The predicted surface stoichiometries are in good agreement with experimental data.

30706 **Hot-electron diffusion lengths in the rare-gas solids.** Gullikson, E. (Center for X-Ray Optics, University of California, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **37**: No. 13, 7904-7906(1 May 1988).

Measurements of the secondary-electron escape probability have been used to determine the escape depth of hot electrons in thin films of Ne, Ar, and Xe. The electrons were generated with 5.9-keV x rays, and the data were analyzed using a diffusion model including absorption at the substrate. The escape depths are measured to be 0.23, 0.45, and 25 μm for Xe, Ar, and Ne, respectively, and appear to be limited by trapping at defects. It is demonstrated that the long escape depths make the rare-gas solids efficient photocathodes for x rays.

30707 **Hot forging characteristics of transformation-toughened Al_2O_3/ZrO_2 composites.** Kellett, B.J.; Lange, F.F. (Materials Department, College of Engineering, University of California, Santa Barbara, California 93106 and University of California, Department of Materials Engineering, Los Angeles, California 90024). *Journal of Materials Research;* **3**: No. 3, 545-551(May 1988).

Fine grain, transformation-toughened Al_2O_3/ZrO_2 (tetragonal, 5—30 vol. %) composites can exhibit both large deformation strains (80%) and strain rates (>0.001 s^{-1}) without tearing, cavitating, or cracking during hot forging at 1500 °C. Deformability increases with ZrO_2 content. The Al_2O_3 grains grow, develop a crystallographic orientation, and form column structures with increasing deformation. The deformation behavior of the composite series primarily depends on the content of the ZrO_2 phase. In this regard, two deformation regimes were observed that appear to be separated by the volume fraction where the ZrO_2 phase might form a connective network.

30708 **High-resolution NMR and synchrotron x-ray powder diffraction study of zeolite ZSM-11.** Toby, B.H.; Eddy, M.M.; Fyfe, C.A.; Kokotailo, G.T.; Strobl, H.; Cox, D.E. (Union Carbide Corporation, Tarrytown, New York 10591). *Journal of Materials Research;* **3**: No. 3, 563-569(May 1988).

High-resolution nuclear magnetic resonance (NMR) spectra and synchrotron x-ray powder diffraction data have been obtained from a well-crystallized highly dealuminated sample of the zeolite ZSM-11. The Rietveld profile technique has been applied to the synchrotron data to give the first detailed refinement of the idealized structure derived ten years ago by distance least-squares modeling methods [G. T. Kokotailo, P. Chu, S. L. Lawton, and W. M. Meier, Nature 275, 119 (1078)], which involves 54 variable atomic positional parameters. The structure is tetragonal (a = 20.065 A, c = 13.408 A at 25 °C) and consistent with the previously reported tetragonal space group I4-barm2, but the NMR spectra indicate local deviations from this symmetry that disappear at 100 °C.ion

30709 **Time-resolved optical studies of oxide-encapsulated silicon during pulsed laser melting.** Jellison G.E. Jr.; Lowndes, D.H.; Sharp, J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6056). *Journal of Materials Research;* **3**: No. 3, 498-505(May 1988). Contract AC05-84OR21400.

Nanosecond time-resolved reflectivity and ellipsometry experiments have been performed on (100) Si wafers encapsulated by 5.5—76.2 nm thick thermal oxides, using pulsed KrF (248 nm) laser energy densities sufficient to melt the Si beneath the oxide. Post-irradiation nulling ellipsometry, optical microphotography, and surface profiling measurements were carried out. It was found that the threshold energy density required to melt the Si varies with oxide thickness; this is explained primarily by the reflective properties of the oxide overlayer. The time-resolved reflectivity and ellipsometry measurements show that rippling of the SiO_2 layer occurs on the 20—40 ns timescale and results in a decrease in specular reflectivity of the rippled silicon surface beneath. Optical model calculations suggest that pulsed laser annealing through a thick oxide layer results in a damaged near-surface silicon layer (~30 nm thick); this layer contains defects that are probably responsible for the degraded performance of devices.

30710 **Simple model for the Auger electron spectroscopy evaluation of thin-film layer growth systems in which substrate—overgrowth atom mixing occurs.** Ece, M.; Vook, R.W. (Department of Physics, Syracuse University, Syracuse, New York 13244-1130). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1036-1039(May 1988).

Previous studies have shown that the variation of Auger electron spectroscopy (AES) intensities with increasing film thickness can be used to determine the mode of growth. The present report deals with two layer growth cases involving the incorporation of impurity atoms in the overgrowth. If substrate atoms mix with overgrowth atoms, each layer is completed earlier than expected. The change in monolayer thickness, escape length of AES electrons, slope of Auger signal during the growth of each layer, and the ratio of adjacent slopes have been derived. The change in these quantities is calculated for an exponentially decreasing substrate atom concentration in the overgrowth and also for the case in which the concentration of impurities stays constant in the film during the deposition. The work concludes by applying the calculations to two real systems.

30711 **Properties of intrinsic and doped a-Si:H deposited by remote plasma enhanced chemical vapor deposition.** Parsons, G.N.; Tsu, D.V.; Lucovsky, G. (Department of Physics, North Carolina State University, Raleigh, North Carolina 27695-8202). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1912-1916(May 1988).

We have grown films of a-Si:H by remote plasma enhanced chemical vapor deposition (RPECVD) with substrate temperatures Ts between 38 and 400 °C and studied the infrared and optical absorbance (including sub-band-gap absorbance), and other photoelectronic properties. The RPECVD films differ from glow discharge (GD) and sputtered films, most notably in the Ts dependence of the hydrogen bonding environments (SiH, SiH_2, etc.) and the photoconductivity. RPECVD films produced with Ts = 235 °C are similar to "device grade" GD films. Based on the differences between these films, we construct a model for the RPECVD deposition process that includes SiH_3 species as precursors to the growth of high-quality films. We also present experimental evidence of the selectability of precursor formation in the RPECVD process.

30712 **Influence of PF_6 dopant concentration on the x-ray photoelectron spectroscopy and ultraviolet photoelectron spectroscopy spectra of poly 3-methylthiophene.** Nelson, A.J.; Glenis, S.; Frank, A.J. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 954-959(May 1988).

X-ray photoelectron spectroscopy and ultraviolet photoelectron spectroscopy techniques have been used to characterize electrochemically grown conductive films of poly (3-methylthiophene) in the PF_6 doped and undoped states. The PF_6 dopant concentration was varied between the undoped and fully doped states. Core-level and valence-level spectra have yielded information on the nature of the polymeric cation and its associated PF_6 anion, as well as structural disorder effects in these polymers. Results have revealed that addition of the PF_6 counterion causes structural disorder within the polymer and that the PF_6 counterion interacts with the highest occupied nonbonding lone-pair orbital, as well as causing shifts in the photoelectric threshold which may indicate the formation of bipolaron bands.

30713 **Neutralization and bonding mechanisms of shallow acceptors at grain boundaries in polycrystalline silicon.** Kazmerski, L.L.; Nelson, A.J.; Dhere, R.G.; Yahia, A.; Abou-Elfotouh, F. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1007-1011(May 1988).

Interactions between shallow acceptors (B, Al, Ga, and In) and hydrogen in polycrystalline Si are investigated. The bonding mechanisms involved in the acceptor neutralization process at grain boundaries are examined using microanalytical techniques. Differences in the incorporation of molecular and atomic hydrogen, and corresponding variations in electrical passivation at grain boundaries, are observed. Low-temperature Auger difference spectroscopy confirms Si—H bonding to dominate B, Ga, and In-doped cases, with no direct acceptor—hydrogen bonding. Al-rich grain boundaries show H-complex and hydroxyl bonding. The data confirm chemical bond strength trends with B<Ga<In. Volume-indexed Auger electron spectroscopy is utilized to compare bonding and H distributions in B- and Al-rich grain boundary regions.

30714 **Copper—silicon interface: Composition and interdiffusion.** Corn, S.H.; Falconer, J.L.; Czanderna, A.W. (Department of Chemical Engineering, University of Colorado, Boulder, Colorado 80309-0424). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1012-1016(May 1988).

The interdiffusion of Cu and Si was studied using ion scattering spectrometry (ISS) and x-ray photoelectron spectroscopy (XPS). The samples were prepared in very high vacuum (VHV) by evaporating Cu onto Ar^+-cleaned and -annealed Si(111) surfaces. The surfaces were transferred directly from VHV to UHV and analyzed by ISS and XPS. Diffusion was studied at 295 K, and then at temperatures up to 825 K. A comparison of data taken at the Cu—Si interface was made with Cu_3 Si. Copper and Si interdiffuse rapidly at 295 K and above; diffusion is completed in <60 min as temperatures are increased up to 825 K, depending on Cu overlayer thicknesses of 2 or 20 nm. In contrast to previously published results, our ISS and XPS data did not provide evidence for the formation of Cu_3 Si at the Cu—Si interface under the range of Cu coverage (2—20 nm) and temperatures (295—825 K) studied. The Cu $2p_{3}2$ peak shifted 0.5 eV to lower kinetic energy for Cu—Si interfaces; this peak does not shift for Cu_3 Si. Furthermore, the compositions of the Cu—Si interfaces and Cu_3 Si differed. Oxide-covered Si surfaces were used in some investigations for comparative purposes, and the effect of O_2 exposure to the Cu—Si interface was also studied. Oxygen contamination on Si substrates was found to retard the interdiffusion process. The Cu—Si interface reacts with O_2 to form oxides of Si; no Cu oxides formed.

30715 **Fractoemission from fused silica and sodium silicate glasses.** Dickinson, J.T.; Langford, S.C.; Jensen, L.C.; McVay, G.L.; Kelso, J.F.; Pantano, C.G. (Physics Department, Washington State University, Pullman, Washington 99164-2814). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1084-1089(May 1988).

Fractoemission is the emission of photons and particles due to the fracture of materials. In this paper we present characteristic intensity versus time measurements of photon emission (phE), electron emission (EE), positive ion emission (PIE), and neutral emission (NE) due to the fracture of fused silica and sodium trisilicate glass. We show, for example, that the trisilicate is a copious emitter of atomic Na and both atomic and molecular oxygen. The phE, EE, and PIE from the two glasses share a number of properties.

30716 **Tribological properties of MoS_2 coatings in vacuum, low relative humidity, and high relative humidity environments.** Panitz, J.K.G.; Pope, L.E.; Lyons, J.E.; Staley, D.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1166-1170(May 1988).

We have rf-sputter deposited MoS_2 coatings onto stainless-steel plates using two extreme combinations of deposition conditions. Raman spectroscopy indicates that there is a small but significant difference in the number of sulfur—sulfur bonds and the amount of amorphous material present in the two types of coatings. The friction and wear properties were evaluated within five days of deposition and after being stored for 150 days in 35%—45% relative humidity followed by over 75 days in (1) 2% or (2) 98% relative humidity environments. The more crystalline material had a coefficient of friction of 0.085 +- 0.017 in lab air and 0.06 +- 0.005 in ultrahigh vacuum. For lab air testing the coefficient of friction increased with wet storage to 0.10 +- 0.01, and the wear life decreased by a factor of 3 for dry storage and by a factor of 10 for wet storage. The MoS_2 material with the larger amount of amor-

phous material has a coefficient of friction of 0.10 +- 0.013 which increased to 0.14 +- 0.04 for storage in the wet environment. The wear life of the MoS_2 coating with the greater amount of amorphous material improved significantly (by 100%) for storage in the wet environment. These results are consistent with the observations of others who noted that water vapor promotes the conversion of MoS_2 to MoO_3.

30717 **Photoluminescence spectra of some ternary and quaternary chalcopyrite semiconductors.** Abou-Elfotouh, F.; Dunlavy, D.J.; Kazmerski, L.L.; Albin, D.; Bachman, K.J.; Menner, R. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1515-1518(May 1988).

Photoluminescence (PL) emission spectra of single crystals and thin films of CuGa/sub x/In_1√/sub x/Se_2 compounds have been investigated at various measuring temperatures, and compared with the emission from $CuGaSe_2$ and $CuInSe_2$. The observed PL spectra consisted of two groups of emission lines: the near-band-gap group (A) and the lower energy group (B). It was found that the type of emission obtained is determined by the amount of stoichiometry and molecularity deviations. The PL data also showed a correspondence between the defect related transitions from the CuGa/sub x/In_1√/sub x/Se_2 solid solution and $CuGaSe_2$ for $x<0.5$. Based on the intrinsic defect states in the two components $CuInSe_2$ and $CuGaSe_2$, the predominant defect states transitions in the solid solution are defined for the $m<1$ and $\Delta S>0$. Interpretation of the PL spectra of Se-deficient compounds with $m>1$ are rather complicated, and much work remains to be done before the defect chemistry of CuGa/sub x/In_1√/sub x/Se_2 could be fully understood.

30718 **Role of strain in Si(111)7 x 7 and related reconstructed surfaces.** Robinson, I.K. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1966-1970(May 1988).

X-ray diffraction measurements of the sputter-annealed Si(111) 7 x 7 surface have been made at the National Synchrotron Light Source, Brookhaven. Technical advances have improved the reliability of such data significantly. The 120 structure factor intensities agree with the widely accepted structural model of Takayanagi at the 4σ level, but can be made to show complete agreement if the atomic coordinates of this model are allowed to relax. In this way, 15 of the 17 possible two-dimensional positional coordinates in three layers have been determined to an accuracy of ~0.02 A. The displacement pattern can be simply interpreted as a superposition of strain fields around the adatoms, in the dimers, and within the triangular island regions. These new observations of strain are discussed in the light of theoretical calculations of the local strain fields around adatoms, observations of reconstructed states of surfaces prepared under external strain, and theoretical attempts to understand the origin of strain.

30719 **Residual hydrogen concentration levels in graphite.** Bastasz, R. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 2116-2118(May 1988).

Hydrogen concentration versus depth profiles obtained with secondary ion mass spectrometry of a high-purity graphite (POCO) indicate that unannealed POCO has a residual subsurface H level on the order of 0.4% H/C. Vacuum annealing to 910 °C for several hours reduces this level by over an order of magnitude. However, reabsorption of hydrogen containing gases during air exposure occurs in the near surface region. Prolonged air exposure brings the residual hydrogen level within 5 μm of the surface back to the levels seen in unannealed POCO samples.

30720 **Copper carboxylate formation in the thermal oxidative degradation of atactic polypropylene on copper oxide films.** Webb, J.D.; Czanderna, A.W.; Pitts, J.R. (Materials Research Branch, Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 997-1001(May 1988).

The thermal oxidation of atactic polypropylene on CuO/sub 0.67/ surfaces in air was studied using Fourier transform infrared reflection—absorption spectroscopy (FT—IR—RA). Degradative losses of primary, secondary, and tertiary alkyl hydrogens were observed. Films of CuO/sub 0.67/ (55 nm thick) were prepared by the thermal oxidation at 122 °C of a copper film on 50 nm of gold, which was supported by a polished fused silica substrate. Thin films (70—200 nm) of purified atactic polypropylene were cast onto the copper oxide from xylene solution at 90 °C and air dried at 22 °C. The samples were heated in situ in the FT—IR—RA apparatus in synthetic or in laboratory air and then mounted for the IR—RA measurements from 600 to 5000 cm^{-1}. At 60 and 73 °C, carboxylic acids are the primary degradation products, while at 85 and 100 °C, copper carboxylate formation predominates, and CuO/sub 0.67/ is decomposed. The distinct change in the oxidative mechanisms between 73 and 85 °C apparently is related to an irreversible thermal transition in the atactic polypropylene films, which may favor carboxylate production by increasing the permeability of the films to oxygen and water vapor.

30721 **Chemical erosion of graphite by hydrogen impact: A summary of the database relevant to diamond film growth.** Hsu, W.L. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1803-1811(May 1988).

It is now established that diamond can be grown by vapor deposition, a condition where graphite is the more thermodynamically stable state. This supposed contradiction of thermodynamics is explained by the recognition that hydrogen is more likely to chemically erode graphite than diamond. In most diamond growth environments, hydrogen gas must be kept above a certain concentration (>95% of the mixture) to deposit films with nearly no graphitic component. This paper discusses the chemical interactions of hydrogen with graphite. The discussion is primarily based on the database collected from studies in the fusion research community. The studies cover interactions using both energetic and low-energy atomic hydrogen. Kinetic models have also been developed which can explain reasonably well the observed interaction characteristics. The majority of the interaction studies used graphite as the target material for hydrogen; a few were also carried out with carbon and diamond films.

30722 **Structural correlations in silicon microclusters.** Feuston, B.P.; Kalia, R.K.; Vashishta, P. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439-4843). *Physical Review [Section] B: Condensed Matter;* **37**: No. 11, 6297-6304(15 Apr 1988). Contract W-31-109-ENG-38.

The pair-correlation and angle-distribution functions for silicon microclusters containing 6–20 atoms have been calculated through molecular-dynamics (MD) simulation with use of the Stillinger-Weber three-body potential. To model the experimental situation where the investigation of the structure of small clusters usually involves a size distribution, we have determined an effective pair-correlation function by folding together the pair correlations of individual clusters. The simulation results indicate that small covalently bonded clusters may undergo structural transformations at temperatures lower than 20% of their bulk melting temperature. This necessitates detailed knowledge of the ensemble of configurations lying above the ground state to explain the experimentally determined structure as well as to explain the existence of the so-called "magic numbers." Our results also show that the presence of a distribution of silicon cluster sizes, each with different topologies, yields an "amorphouslike" pair-correlation function with the nearest-neighbor distance of crystalline silicon and an angle distribution peaked about 90° and 108°.

30723 **Ordered-vacancy-compound semiconductors: Pseudocubic $CdIn_2Se_4$.** Bernard, J.E.; Zunger, A. (Solar Energy Research Institute, Golden, Colorado 80401). *Physical Review [Section] B: Condensed Matter;* **37**: No. 12, 6835-6856(15 Apr 1988). Contract AC02-77CH00178.

Whereas substitutional adamantine compounds A/sub n/B/sub 4-n/C_4 (e.g., ABC_2 chalcopyrites for n = 2, or the AC and BC

zinc-blende compounds for n = 4 and 0) have four metal atoms around each nonmetal atom and vice versa, ordered-vacancy compounds OVC's) AB_2C_4 have but three metal atoms (one A and two B's) around each nonmetal site (C) while the fourth (unoccupied) site forms an ordered array of vacancies. An example for OVC's is "pseudocubic" $CdIn_2Se_4$ which can be structurally derived from the layered alternate monolayer superlattice of CdSe and InSe (along the [001] direction) by removing half of the Cd atoms from each Cd plane. Such OVC's form a natural bridge between crystal and impurity physics. Much like the metal vacancy in II-VI compounds (e.g., CdSe), the vacancy in $CdIn_2Se_4$ has associated with it (nonmetal) "dangling bonds" and "lone-pair" electrons, which, however, form a dispersed band in the crystal. Using all-electron mixed-basis electronic-structure techniques, we study the properties of such an ordered array of vacancies in $CdIn_2Se_4$ vis-a$ga: -vis the experimental data.

30724 **Character of the α-β phase transition in solid oxygen.** LeSar, R.; Etters, R.D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 10, 5364-5370(1 Apr 1988).

Properties of the α and β phases of solid O_2 are calculated with a deformable-cell Monte Carlo method and the character of the associated phase transition is delineated. We find that the monoclinic α phase is stable at temperatures Tapprox. <18 K and in- and out-of-plane antiferromagnetic order is predicted that is in accord with experiment. The magnetic correlations appear to be long ranged. A phase transition into β-O_2 occurs at T = 17.75 +- 0.2 K. It is first order with a calculated volume change ΔV = 0.06 +- 0.10 cm$mole, and is accompanied by a magnetic transition into a highly dynamic quasihelical state with a correlation length l/sub c/ = 8 +- 1 A at 18 K, that decreases rapidly with increasing temperature. The results indicate that O_2 behaves as a two-dimensional magnetic system. The molecular axes exhibit temperature dependent, small angle libration about an axis normal to the basal plane and there is no evidence of precession in β-O_2. There is also no evidence of magnetic reordering in the α phase as a precursor to the transition.

30725 **X-ray studies of high-temperature defects in concentrated isotopic helium solid solutions.** Fraass, B.A.; Simmons, R.O. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review [Section] B: Condensed Matter;* **37**: No. 10, 5058-5069(1 Apr 1988). Contract AC02-76ER01198.

Vacancy concentrations in bcc crystals of helium isotope mixtures of nominal composition 12%, 28%, and 51% ^{3}He have been inferred from measurements of temperature dependence of x-ray lattice parameter, a, in samples confined at several different constant macroscopic volumes. The data have been parametrized by an activated form, and in each case some possible separation of the free energy into energy and entropy contributions is discussed. The results for each composition are different, yet certain patterns can be discerned, such as the likelihood of significant vacancy-solute binding. Estimates of the vacancy free volume of formation are obtained for the 28% and 51% ^{3}He mixtures. In low-density 51% crystals the changes in 3 Δaa are extraordinarily large, up to 5% near melting. The situation is reminiscent of CsCl-structure alloys, except that those alloys show ordering at all temperatures, whereas helium mixtures show isotopic phase separation at low temperatures.

30726 **Indirect-direct anticrossing in GaAs-AlAs superlattices induced by an electric field: Evidence of Γ-X mixing.** Meynadier, M.; Nahory, R.E.; Worlock, J.M.; Tamargo, M.C.; de Miguel, J.L.; Sturge, M.D. (Bell Communications Research, Red Bank, New Jersey 07701). *Physical Review Letters;* **60**: No. 13, 1338-1341(28 Mar 1988).

We demonstrate that a GaAs-AlAs superlattice can be switched from indirect to direct, in both real and reciprocal spaces, by application of a modest axial electric field. The crossover region is found to be an anticrossing, manifesting the presence of Γ-X mixing by a potential measured to be of the order of 1 meV. This value is corroborated by time-decay measurements performed on different superlattices.

40 CHEMISTRY

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 30505, 30650, 30672, 30812, 30828, 30829, 30990, 31001, 31003, 31136, 31184, 31185, 31196

30727 **(AD-A—189457/5/XAB) Navy-fuels analytical chemistry. Final report, 10 November 1986-16 November 1987.** Mach, M.H. (TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.). 20 Dec 1987. 37p. (TRW—47946-6005-UT-00). NTIS, PC A03/MF A01.

The objective of this program was to develop analytical methods for the separation, quantitation, and identification of sulfur compounds in JP-5 turbine fuels. The principal accomplishments were 1) HPLC methods to separate benzothiophenes and sulfide/disulfides from as-received fuel, 2) the development of the Integrated Sulfur Detector, a modification of the Hall GC detector, permitting the quantitation of nanogram amounts of sulfur in HPLC fractions, 3) preliminary GC/MS analysis of the separated fractions.

30728 **(CONF-860970—4) Development of a method for the recovery of the enzyme cellulase from aqueous solution.** Woodward, J.;Baird, A.R.;Parrish, C. (Oak Ridge National Lab., TN (USA)). [1986]. Contract AC05-84OR21400. 3p. NTIS, PC A; 02; GPO Dep. Order Number DE88007278/JAW.

From 3. world congress on chemical engineering; Tokyo, Japan (21 Sep 1986).

The asdorption of cellulase onto several inorganic particulate materials has been measured. None adsorbed cellulase to any great extent. Concanavalin A, covalently bound to inorganic kieselguhr granules, has high adsorption capacity for cellulase. When cellulase absorbed on this support was mixed with cellulose (Avicel) particles, hydrolysis of cellulose proceeded. The enzyme had desorbed from the support and adsorbed onto cellulose. 6 refs., 7 figs., 3 tabs.

30729 **(CONF-870733—16) Spectral processing and quantitative analysis in electron energy loss spectroscopy using a digital filter technique.** Zaluzec, N.J. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 18p.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

Digital filtering of EELS data provides a simple, rapid and nearly operator independent method of both qualitatively and quantitatively analyzing spectra recorded under a wide range of experiment conditions. A particuliarly important application where digital filtering would prove useful is in the stripping of background from closely spaced edges, or edges having poor peak/background ratios, conditions under which conventional background modeling techniques sometimes pose severe limitations. The results of this study have shown that the technique is relatively stable with respect to thickness variation and experimental operating conditions, and can be made quantitative by use of normalized reference spectra. Further work is in progress in order to evaluate the potential difficulty associated with the changes in near edge profiles resulting from changes in the density of states as they affect quantification. 9 refs., 6 figs.

30730 **(CONF-880435—5) Influence of laser characteristics on resonance ionization mass spectrometry.** Young, J.P.; Shaw, R.W.; Goeringer, D.E.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. (CONF-880435—).

From 4. international symposium on resonance ionization spectroscopy and its applications; Gaithersburg, MD, USA (10 Apr 1988).

Differences are observed among investigators for similar elements studied by resonance ionization mass spectrometry (RIMS). The differences include wavelengths of RIMS transitions, atom sensitivity, and isotope ratio bias measurements. A comparative RIMS study of several 1+1+1 ionization routes for neodymium in the

5800 to 6200 A spectral region using flashlamp, copper vapor laser, and Nd:YAG laser pumped dye lasers is reported here. The lasers chosen have inherent differences in lasing characteristics, such as mode structure, pulse length, peak power and pulse frequency. 5 refs., 1 fig., 2 tabs.

30731 **(DOE/ER/00854—44) Fundamental studies of separation processes:.** Rogers, L.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 1988. Contract AS09-76ER00854. 13p.

This report deals primarily with chromatographic studies, many of them concerned with factors which are improtant in separations of isomeric species, and some exploring effects of using different solvent sand different column packings. Concurrent NMR studies showed that some chemical shifts could be correlated with the relative orders of elutions of enantiomers and with energies of interactions calculated using Allinger's molecular mechanics program, MM2. In addition, two feasibility studies have been done. The first used a computer-controiled linear pH gradient by mixng a strong acid and strong base to fractionate a mixture of weak organic acids. The second demonstrated the advantage of using 1 mm glass beads as a column support in recycle gas chromatography. Finally, two papers dealt with the long-standing problem of discrepancies found in quantitative trace determinations obtained when different laboratories analyze differnt portions of the same sample.

30732 **(DOE/ER/05015—T5) Mechanisms of gas permeation through polymer membranes: Final report and renewal proposal for period December 1, 1986-November 30, 1989.** Stern, S.A. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). 1988. Contract AC02-78ER05015. 82p. NTIS, PC A; 05/MF A01; GPO Dep. Order Number DE88007436/JAW.

The recent progress in membrane separation technology can be sustained only through the development of new types of polymer membranes with a higher intrinsic permeability and selectivity for specified gases. Objectives of this project are to investigate the mechanisms of transport of small molecules in and through nonporous polymers membranes, as well as the dependence of these mechanicms on polymer structure. Both experimental and theoretical studies will be conducted. (DLC)

30733 **(DOE/PC/80532—11) On line multielement determination of coal slurries using a direct current plasma: Technical report, October 1987-December 1987.** McCreary, T.W.; Yoon, R.H.; Long, G.L. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Chemistry). 23 Mar 1988. Contract FG22-85PC80532. 6p.

The addition of 1% PEO (polyethylene oxide) to the coal slurry results in 100% recovery for 5 determinations using DCP-AES. Particle sizes of up to 20 um can be used to obtain unity recovery. Unlike other spectrometric techniques to determine S, this is the first report of obtaining unity recovery of S for particles of this size. The result of using PEO will enable DCP-AES to function as a on-line sensor for S in coal. 3 figs.

30734 **(INIS-BR—1048) Characterization lithium mineralized pegmatite.** Pereira, E.F.S.; Luz Ferreira, O. da; Cancado, R.Z.L.; Mauricio Neto, J. (Minas Gerais Univ., Belo Horizonte (Brazil). Escola de Engenharia). 1986. 11p. (In Portuguese). (CONF-8611238—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702312/JAW.

From 41. annual congress of the Brazilian Association of Metals; Sao Paulo, Brazil (9 Nov 1986).

Lithium economic importance has increased in the last years. In Brazil its reserves, generally pegmatites bodies, are found in Itinga-Aracuai-MG. This study of characterization belongs to a global plan of lithium mineralized bodies research of 'Arqueana de Minerios e Metais Ltda', which purpose is to give subsidies for implementation of pegmatite unit, in order to make better use of them. (F.E.).

30735 **(IS-T—1319) Separation and determination of trace metal ions using organic chelating reagents.** Palmieri, M.D. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 238p. NTIS, PC A11/MF A01;1; GPO Dep. Order Number DE88007353/JAW.

The four reagents tested were N,N-dihexylacetamide (DHA), 2,6-diacetylpyridine bis(furoylhydrazone) (H_3dapf), 1,3-dimethyl-4-acetyl-2-pyrazolin-5-one (DMAP) and N-methylfurohydroxamic acid (NMFHA). DHA and H_3dapf were investigated for their complex formation with uranium, and DMAP and NMFHA were used as chelating agents in high performance liquid chromatography (HPLC). Uranium(VI) is preferentially extracted from nitric acid solutions using DHA in toluene. The extraction characteristics of the U-DHA complex are studied. A 119,000 μgL^{-1} U solution is analyzed for twenty-six elements. The U is extracted with DHA, and the trace metal ions are then determined by inductively coupled plasma-mass spectrometry. Uranium must be removed from the sample before analysis to prevent ionization suppression. H_3dapf is synthesized and characterized. Studies of the complexation of metal ions with H_3dapf is described. U(VI) forms a stable complex with H_3dapf, and a procedure for selectively determining trace U by spectrophotometry is presented. DMAP complexes of Cu(II), Fe(III), Ga(III), Th(IV), U(VI), V(V), and Zr(IV) are separated using reversed phase HPLC. NMFHA complex of Al(III), Fe(III), Hf(IV), Nb(V), Sb(III), and Zr(IV) are separated using reversed phase HPLC. NMFHA is also used to separate uranium(VI) from trace lanthanide ions. 266 refs., 46 figs., 24 tabs.

30736 **(KFK—4346) Determination of Am-241, Cm-242 and Cm-244 in environmental samples.** Afsar, M.; Schuettelkopf, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Sicherheit). Jan 1988. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753582/JAW.

An analytical procedure for the determination of Am and Cm in environmental, liquid and gaseous effluent samples was developed. It is based on extraction chromatography with subsequent anion and cation exchange to remove matrix elements and to purify Am and Cm, which are then electrode posited from an oxalateHCl medium. The mean value of the chemical yield is about 90%. A detection limit of 7 μBqg is achieved. The decontamination factors for important α emitters are $> 10^4$. Four analysesweek can be performed by one technician.

30737 **(NUCLEBRAS-CDTN—529) Determination of residual gases in nuclear materials by vacuum fusion.** Ferreira, M.P.; Monteiro, R.P.G. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 12p. (In Portuguese). (CONF-860343—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701696/JAW.

From 1. general congress on nuclear energy; Rio de Janeiro, Brazil (17 Mar 1986).

The presence of residual gases (hydrogen, nitrogen and oxygen) in nuclear materials considerably affects their mechanical and thermal properties. This problem has stimulated the development of precise and efficient methods of analysis, applicable to the determination and quality control of impurities in these materials. The most suitable technique for this purpose is high vacuum fusion. The feasibility of the method was checked with steel, Zircaloy and nuclear fuel samples. The results experimentally determined are in good agreement with the specified values.

30738 **(PB—88-170683/XAB) Fourier-transform infrared photoacoustic spectroscopy characterization of sulfur-oxygen species resulting from the reaction of SO_2 with CaO and $CaCO_3$.** Martin, M.A.; Childers, J.W.; Palmer, R.A. (Duke Univ., Durham, NC (USA). Paul M. Gross Chemical Lab.). 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Applied Spectroscopy, Vol. 41, No. 1, 120-126(1987).

Fourier-transform infrared photoacoustic spectroscopy (FTIR-PAS) has been used to investigate the reaction of SO_2 in He with CaO and $CaCO_3$ particles at temperatures between 25 and 900 C. SO_2 reacts with CaC at 25 C, while the reaction of Ca-CO_3 with SO_2 is first evident at 550 C (the initial product of both reactions is $CaSO_3$). The $CaSO_3$ then further reacts with SO_2 to form $CaSO_4$, CaS_2O_3, and CaS at higher temperatures. At 900 C and above, the net production of SO_4(--) and S_2O_3(--) is decreased due to the decomposition of SO_3(--). FTIR-PAS depth profiling experiments indicate the formation of a reaction-limiting product layer of SO_3(--) and SO_4(--) from the above reactions on the surface of the CaO and $CaCO_3$ particles.

30739 (PB—88-189758/XAB) Handbook of Basic Tables for Chemical Analysis. Final report. Bruno, T.J.; Svoronos, P.D.N. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Engineering). Apr 1988. 932p. (NBSIR—88/3085). NTIS, PC A99/MF E04.

See also PB—86-227113.

This work began as a slim booklet prepared by one of the authors (TJB) to accompany a course on chemical instrumentation presented at the National Bureau of Standards, Boulder Laboratories. The booklet contained tables on chromatography, spectroscopy, and chemical (wet) methods, and was intended to provide the students with enough basic data to design their own analytical methods and procedures. Shortly thereafter, with the co-authorship of Prof. Paris D. N. Svoronos, it was expanded into a more-extensive compilation entitled Basic Tables for Chemical Analysis, published as National Bureau of Standards Technical Note 1096. That work has now been expanded and updated into the present body of tables. Although there have been considerable changes since the first version of these tables, the aim has remained essentially the same. The authors have tried to provide a single source of information for those practicing scientists and research students who must use various aspects of chemical analysis in their work. In this respect, it is geared less toward the researcher in analytical chemistry than to those practitioners in other chemical disciplines who must have routine use of chemical analysis.

30740 (SAND—88-0212) Round robin analysis of non-silicate CABAL-12 glass; The establishment of a standard reference material. Merrill, R.M. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 37p.

CABAL-12, a non-silicate based glass formulated at Sandia, is nominally composed of 11.94% MgO, 16.61% CaO, 41.25% B_2O_3, and 30.20% Al_2O_3 by weight, and is highly resistant to lithium corrosion. Because of its unique formulation, there is no reference standard for the glass; therefore, a found robin analysis was undertaken to establish such a standard. The material used was a single cylindrical billet of CABAL-12 poured for Sandia by the Schott Glass Company. The 8 kg billet, which was 16 cm high, 15 cm in diameter, was sampled at five locations, and the samples were treated as discrete unknowns. The four constituents in each of the five samples were analyzed in quadruplicate by the four participating laboratories. In addition, two of the laboratories performed emission spectrographic analyses to characterize trace contaminants, and the physical properties of each of the samples were determined by Sandia's glass laboratory. The results of the analyses show that the billet was homogeneous throughout. A statistical analysis was done on the data, and the 95% confidence intervals for the composition of the reference material were: 11.40 +-0.27% MgO, 16.09 +-0.57% CaO, 43.93 +-0.36% B_2O_3, and 28.42 +-0.36% B_2O_3, and 28.42 +-0.54$ Al_2O_3. 5 figs., 10 tabs.

30741 Hindered internal rotation in some singly methylated trans-stilbenes. Spangler, L.H.; Bosma, W.B.; van Zee, R.D.; Zwier, T.S. (CLS-2, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **88**: No. 11, 6768-6777(1 Jun 1988).

The fluorescence excitation and several dispersed fluorescence spectra for supersonically cooled p-methyl-trans-stilbene and the two m-methyl-trans-stilbenes are presented. Despite significant spectral congestion present in these molecules which contain low frequency modes and internal rotation structure, nearly complete assignments of the excitation spectra are given. One notable transition is assigned as a combination of a nontotally symmetric vibration and a nontotally symmetric level of the methyl rotor. All three species have a ground state barrier to internal rotation of ~28 cm^{-1}. Excited state barriers and conformational changes observed on excitation are 150 cm^{-1} and 35° for p-Me, and 80 cm^{-1} and 60°, and 186 cm^{-1} and 30° for the two m-Me compounds. The p-Me compound shows a threefold barrier to internal rotation rather than a sixfold one, indicating that the two meta positions are inequivalent. The large differences in barrier height and conformational change on excitation between the two meta isomers, whose origins are separated by 207 cm^{-1}, confirm this inequivalence.

30742 Spectroscopic identification of surface phenyl thiolate and benzyne on Mo(110). Roberts, J.T.; Friend, C.M. (Department of Chemistry, Harvard University, Cambridge, Massachusetts 02138). *Journal of Chemical Physics;* **88**: No. 11, 7172-7180(1 Jun 1988).

Chemisorbed phenyl thiolate (C_6H_5S) and surface benzyne (C_6H_4) formed during the temperature programmed reaction of benzenethiol on Mo(110) have been characterized using x-ray photoelectron and high resolution electron energy loss spectroscopies. Electron energy loss spectroscopy demonstrates that at all exposures the S—H bond of benzenethiol breaks upon adsorption at 120 K, while x-ray photoelectron spectroscopy confirms that the C—S bond is intact. The intermediate formed upon adsorption is assigned as a chemisorbed phenyl thiolate. At high exposures, approximately 40% of the phenyl thiolate reacts by way of hydrogenolysis at 350 K to form gaseous benzene and atomic sulfur, while 60% undergoes dehydrogenation at ≅370 K to form surface benzyne and atomic sulfur. Electron energy loss spectroscopy reveals that surface benzyne is aromatic in nature, and x-ray photoelectron spectroscopy confirms that the C—S bond is no longer intact. Surface benzyne is unusually stable on the sulfided Mo(110), decomposing at 680 K to gaseous dihydrogen and atomic carbon, with an activation energy of 42 kcal/mol in the limit of high coverage. At low coverages, the phenyl thiolate decomposes on Mo(110) to surface carbon, surface sulfur, and gaseous dihydrogen, with decomposition complete below 600 K. At low coverages, no formation of gaseous benzene or surface benzyne occurs. The coverage dependence of the reaction kinetics of the phenyl thiolate on Mo(110) are attributed, in part, to a change in the structure of the adsorbed thiolate at high coverages.

30743 Retention in supercritical fluid chromatography: influence of the partial molar volume of the solute in the stationary phase. Yonker, C.R.; Smith, R.D. (Pacific Northwest Lab., Richland, WA (USA)). *Journal of Physical Chemistry;* **92**: No. 6, 1664-1667(24 Mar 1988). Contract AC06-76RL01830.

Theoretical models for retention in supercritical fluid chromatography have described solute retention based on statistical thermodynamics or classical thermodynamic models of mobile-phase interactions with the solute. The shortcomings of these models largely reside in the assumption of pressure-independent solute-stationary phase interactions with supercritical fluids. The pressure dependence of the partial molar volume of the solute in the stationary phase and the role of the partial molar volume of the solute in the stationary phase on retention in supercritical fluid chromatography are discussed based upon experimental studies with CO_2 over a wide range of fluid pressures.

30744 Novel approach to the determination of iridium via Ge-coincidence/NaI(Tl)-anticoincidence gamma-ray spectrometry. Cumming, J.B.; Parekh, P.P.; Murali, A.V. (Brookhaven National Lab., Upton, NY (USA). Dept. of Chemistry; New York State Dept. of Health, Albany (USA). Wadsworth Center for Labs. and Research; Lunar and Planetary Inst., Houston, TX (USA)). *Nuclear Instruments and Methods in Physics Research;* **265**: No. 3, 468-474(15 Mar 1988). Contract AC02-76CH00016.

Iridium has proven to be a useful fingerprint of extraterrestrial material, and neutron activation analysis is the method of choice for its determination because of the high thermal cross section (910 b) of ^{191}Ir (37.3% natural abundance) and the favorable decay characteristics of the product nuclide. However, radiochemical separations are frequently required for the determination of iridium at low concentrations (in the ppb range). The present work describes a precise, nondestructive neutron-activation procedure that is capable of analyzing samples of both high (ppm) and low (ppb) Ir content. Advantage is taken of the fact that the principal gamma lines of 73.8-d ^{192}Ir are in various coincidences with one another. Instead of conventional gamma-gamma coincidence spectrometry with two Ge detectors, we utilize the 784.6- and 920.9- keV sum peaks which are generated when an iridium containing sample is placed in the well of a highly-efficient HPGe detector. The well-type detector is positioned centrally in a large annular NaI(Tl) detector which is operated in an anticoincidence mode. This improves

the quality of the gamma spectra by suppressing the Compton backgrounds due to nuclides such as ^{60}Co by a factor of 4-6 in the regions of interest without affecting the intensities of the two sum peaks. The sensitivity of this method under our experimental conditions (20-mg sample irradiated at $1.5x10^{14}$ n cm^{-2} s^{-1} for 5 min and counted 3-4 weeks after irradiation) is ≃ 5 ppb Ir in a relatively unfavorable matrix such as peridotite.

30745 **Effect of propane on atomic spectrometric signals in the direct-current plasma.** McCreary, T.W.; Long, G.L. (Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Applied Spectroscopy;* **42**: No. 3, 390-394(Mar 1988).

The addition of small amounts of propane to the direct-current plasma (DCP) affects the emission signal of analyte species in the plasma. In the normal analytical region of the plasma, a reduction in emission is seen; this reduction can be accounted for by a decrease in excitation temperature caused by the propane in this region of the plasma. Above the analytical region, an enhancement in atomic emission is seen. The excitation temperature in this region of the plasma was found to remain unchanged when propane was added. The mechanism for the enhancement is thought to be the reduction of metal oxides to the corresponding free metal by carbon. Evidence for the mechanism is provided by recognition of the fact that a large reservoir of atomic carbon exists in this region of the plasma and by examination of the behavior of slurries of the metal oxides, introduced into the plasma via a Babington nebulizer.

30746 **Detector for liquid chromatography and flow injection analysis using surface-enhanced Raman spectroscopy.** Freeman, R.D.; Hammaker, R.M.; Meloan, C.E.; Fateley, W.G. (Kansas State University, Department of Chemistry, Willard Hall, Manhattan, Kansas 66506). *Applied Spectroscopy;* **42**: No. 3, 456-459(Mar 1988).

A successful interface between a high-performance liquid chromatograph and a Raman spectrometer is described. Surface-enhanced techniques are utilized to overcome the sensitivity problem inherent to conventional Raman spectrometry by adding a Ag sol to the chromatographic effluent in a post-column mixing coil. The system is designed so that Raman spectra may be obtained from chromatographic effluent or from flow injection analysis effluent. A common organic dye (pararosaniline hydrochloride) is used to evaluate the reproducibility, dynamic range, and analytical capabilities of the system. The SERS instrument is found to be a viable detector for HPLC and FIA, capable of providing structural information with a sensitivity comparable to that of other commonly used HPLC detectors.

30747 **Analysis of the vibrational characteristics of zeolites using factor group methods.** Maroni, V.A. (Materials Science Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439). *Applied Spectroscopy;* **42**: No. 3, 487-493(Mar 1988).

The complete group theoretical representations for the normal modes of twelve high-symmetry zeolite crystal structures (including sodalite, offretite, and zeolite rho, as well as A, X, Y, and L-type zeolites) have been determined by factor group analysis. Comparisons of the predicted number of raman and infrared active vibrations were made with existing experimental data in cases where such data were available. The prospects for conducting detailed analyses of the vibrational dynamics of zeolite framework structures based on the factor-group-derived representations were also examined. Much of the accepted intuitive understanding of zeolite vibrational spectra is confirmed by the findings of this work: e.g., that the number of predicted Raman and infrared frequencies (1) is consistently far greater than the number actually observed and (2) depends more on the level of symmetry of the zeolite crystal than on the number of atoms in the Bravais unit cell. Tight overlapping of frequencies, particularly those that are primary bond stretching in nature, is to be expected.

30748 **Pressure swing adsorption for a system with a Freundlich isotherm.** Lu, X.; Rothstein, D.; Madey, R.; Huang, J.C. (Kent State Univ. OH (USA)). *Separation Science and Technology;* **22**: No. 6, 1547-1556(Jun 1987).

An analytical expression is obtained for the equilibrium relationship between the enrichment factor of the product stream and the ratio of the pressure in the feed stream to that in the product stream for a pressure-swing-adsorption system with a Freundlich isotherm. The enrichment factor is the ratio of the mole fraction of the adsorbate in the product gas stream to that in the feed gas stream. The enrichment factor increases with increasing pressure ratio in a manner similar to that for a system with a linear isotherm. The nonlinearity of the Freundlich isotherm does not result in a significant reduction in the enrichment factor.

30749 **Neutron diffraction study of zoisite at 15 K and X-ray study at room temperature.** Smith, J.V.; Pluth, J.J.; Richardson, J.W. Jr.; Kvick, A. (Chicago Univ., IL (USA). Dept. of Geophysical Sciences; Brookhaven National Lab., Upton, NY (USA). Dept. of Chemistry). *Zeitschrift fuer Kristallographie, Kristallgeometrie, Kristallphysik, Kristallchemie;* **179**: No. 1-4, 305-321(1987).

The crystal structure of zoisite, $Ca_2Al_3Si_3O_{12}OH$; Pnma, Z=4, was determined for crystals of the tanzanite gem variety at 15 K (neutron diffraction, a = 16.218(3), b = 5.5406(14), c = 10.033(3) A) and room temperature, ≃ 295 K (X-ray diffraction, a = 16.1909(15), b = 5.5466(5), c = 10.0323(6) A). Only one proton position was located with positional coordinates 0.2690(1), 0.25, 0.9753(2) and population factor 0.98(1) at 15 K. It forms a hydroxyl group with O(10) at 0.986(2) A and a hydrogen bond with O(4) at 1.757(2) A. There is no diffraction evidence of a second proton position to explain the weak infrared absorption at 2160 cm^{-1} at room temperature for both natural and synthetic zoisites; however, the detection level of 0.01 atom at the 2 σ level might be insufficient. The possibility of hydrogen bonding to two O(2) at 2.96 A from O(10) is discussed. Because the displacement ellipsoid of the proton at 15 K is oblate and smaller than the ones in staurolite, it is concluded that there is only a single center of motion of the proton. The wide ranges of Ca-O, Al-O and Si-O distances are consistent with valence balancing in which short distances go to oxygen atoms with low values of formal bond strength. The displacement ellipsoids at 295 K can be explained qualitatively by anisotropic thermal motion constrained by the bonding to the nearest neighbors. There is an additional overall anisotropy at 15 K which is unexplained. However, values of B/sub iso/ are consistent with zero-point motion, and there is no evidence for positional disorder.

30750 **(UCRL-Trans—12206) Anomalous peaks caused by existing water.** Masuda, Yoshihiro. Translated from *Shitsuryo Bunseki ;* **19**: 150-157(1971). 15p.

When water vapor is induced to a mass spectrometer which is generally used, besides an ion regarded as H_2O, many peaks such as me 12, 27, 28, or 44 are observed. They are formed by an interaction of dirt on the ion source, in the analytical tube, and ions remaining in vacuum, and this interaction forms a background. As a result, when analyzing while water is contained by using a mass spectrometer, analytical errors tend to occur, due to an abnormal spectrum; as a result, removing as much water as possible is recommended.

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REFER ALSO TO CITATION(S) 29848, 29849, 29852, 29854, 29860, 29861, 29884, 29925, 29933, 29934, 29992, 30169, 30171, 30389, 30648, 30650, 30720, 30724, 31002, 31060, 31131, 31222, 31248, 31280, 31441, 31461, 31466, 31485

30751 **(AEEW-R—1973) High temperature studies of simulant fission products: part IV. Interaction of caesium iodide with boric acid over the temperature range 400 to 1000°C.** Bowsher, B.R.; Nichols, A.L. (UKAEA Atomic Energy Establishment, Winfrith). Jul 1985. 69p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752728/JAW.

A thermal gradient system has been used to study the interaction of caesium iodide with boric acid in various atmospheres over the temperature range from 400 to 1000°C. Specific analytical techniques have been used to determine the reaction products, and differential thermal analysis-thermogravimetric studies have been undertaken to assess the reaction kinetics. Solid caesium iodide and molten boric acid react in a diffusion-controlled manner with an activation energy of 190 +- 30 kJ mol^{-1} to give complex caesium

borates (eg $Cs_8B_{10}O_{16}$) and hydrogen iodide. This volatile iodine species interacts with 304 stainless steel to produce nickel and iron-based iodides within the surface oxide layer of the metal.

30752 **(CEGB-TPRD/B—0889/R87) Transfer of volatile species from a pool of water into air.** Hewison, R.C.; Rodliffe, R.S. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jan 1987. 22p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753603/JAW.

The transfer of iodine and other volatile species between gaseous and aqueous phases is an important step in determining fission product retention in most PWR accidents. It is likewise important for the assessment of hypothetical flask transport accidents. A general formulation of interfacial transfer has been developed which enables the role of interfacial kinetics to be considered. The analysis is applied to PWR fuel storage and refuelling pool accidents such as partial/total loss of the cooling system and the latter stages of release from fuel accidentally damaged in handling. Particular attention is paid to assumptions and their justification.

30753 **(CONF-870701—15) Excited states in hydrocarbons.** Lipsky, S. (Minnesota Univ., Minneapolis (USA). Dept. of Chemistry). 1987. Contract FG02-85ER13404. 5p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006688/JAW.

From 8. international congress of radiation research; Edinburgh, UK (19 Jul 1987).

In this brief review we first summarize some pertinent features of the photophysical properties of excited states of hydrocarbons and the mechanisms by which they transfer energy to solutes and then review their yields and their behavior under fast-electron irradiation conditions. 33 refs.

30754 **(DOE/ER/10861—8) Metalloporphyrins as energy transfer catalysts: Progress report, August 1, 1984-July 31, 1987.** Sprio, T.G. (Princeton Univ., NJ (USA). Dept. of Chemistry). 1987. Contract AC02-81ER10861. 12p.

Porphyrin excited state dynamics have been explored initially using a simple stationary sample cw laser technique to pump a steady state; the ground state spectrum is obtained by spinning the sample, and the excited state spectrum is obtained by subtraction. In this way triplet state Resoannce Rama (RR) spectra were obtained for the tetraphenylporphine (TPP) complexes of magnesium, zinc, and palladium, and excited state deligation was studied for pyridine and piperidine complexes of nickel TPP. In connection with the latter study, the systematics of RR frequencies and core size were established for 4- and 6-coordinate nickel porphyrins, and a 5-coordinate high-spin complex was definitively characterized. In addition RR spectra were analyzed for ruthenium porphyrins, as background for future excited state studies, and backbonding charcteristics were established. Charge transfer excited states of a 4,4′-bipyridine complex of ruthenium(II) were studied via the power-dependent photoinduced RR spectra produced with a YAG laser. RR spectra of metallo-OEP (octaethylporphyrin) cation radicals have also been studied.

30755 **(DOE/ER/13529—T1) Molecular orbital studies of the bonding in heavy element organometallics: Progress report.** Bursten, B.E. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 22 Mar 1988. Contract FG02-86ER13529. 24p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007765/JAW.

Over the past two years we have made considerable progress in the understanding of the bonding in heavy element mononuclear and binuclear complexes. For mononuclear complexes, our strategy has been to study the orbital interactions between the actinide metal center and the surrounding ligands. One particular system which has been studied extensively is X_3AnL (where X = Cp, Cl, NH_2; An = actinide; and L = neutral or anionic ligand). We are interested not only in the mechanics of the An-X orbital interactions, but also how the relative donor characteristics of X may influence coordination of the fourth ligand L to the actinide. For binuclear systems, we are interested not only in homobimetallic complexes, but also in heterobimetallic complexes containing actinides and transition metals. In order to make the calculations of such large systems tractable, we have transferred the Xα-SW codes to the newly acquired Cray XMP24 at the Ohio Supercomputer Center. This has resulted in significant savings of money and time.

30756 **(DOE/ER/13583—2) Macrocyclic ligands for uranium complexation: Progress report, August 15, 1987-present.** Potts, K.T. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Chemistry). Mar 1988. Contract FG02-86ER13583. 22p.

The synthesis of several macrocyclic ligands, designed by a computer modeling approach for the complexation of the uranyl ion, has now been completed and their structures established. Preliminary indicate that these macrocycles successfully complex the uranyl ion. Other synthetic efforts have led to a variety of intermediates suitable for final ring closure to the desired macrocycles, providing appreciable potential for variation of the macrocyclic peripheral atoms. A 1:1-uranyl ion complex of one of these precursor products has been shown to undergo a DMSO-induced rearrangement to a 2:1 uranyl ion to ligand complex, both structures having been established by single crystal x-ray data. 10 refs.

30757 **(DOE/PC/70024—T9) Synthesis gas solubility in Fischer-Tropsch slurry: Final report.** Chao, K.C.; Lin, H.M. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1988. Contract AC22-84PC70024. 152p.

The objective is to investigate the phase equilibrium behavior of synthesis gases and products in a Fischer-Tropsch slurry reactor. A semi-flow apparatus has been designed and constructed for this purpose. Measurements have been made for hydrogen, cabon monoxide, methane, ethane, ethylene, and carbon dioxide in a heavy n-paraffin at temperatures from 100 to 300{degree}C and pressures 10 to 50 atm. Three n-paraffin waxes: n-eicosane ($n\text{-}C_{20}$), n-octacosane)$n\text{-}C_{28}$), and n-hexatriacontane ($n\text{-}C_{36}$), were studied to model the industrial wax. Solubility of synthesis gas mixtures of H_2 and CO in $n\text{-}C_{28}$ was also determined at two temperatures (200 and 300{degree}C) for each of three gas compositions (40.01, 50.01, and 66.64 mol%) of hydrogen). Measurements were extended to investigate the gas solubility in two industrial Fischer-Tropsch waxes: Mobilwax and SASOL wax. Observed solubility increases in the order: H_2, CO, CH_4, CO_2, C_2H_4, C_2H_6, at a given temperature pressure, and in the same solvent. Solubility increases with increasing pressure for all the gases. Lighter gases H_2 and CO show increased solubility with increasing temperature, while the heavier gases CO_2, ethane, and ethylene show decreased solubility with increasing temperature. The solubility of methane, the intermediate gas, changes little with temperature, and shows a shallow minimum at about 200{degrees}C or somewhat above. Henry's constant and partial molal volume of the gas solute at infinite dilution are determinedfrom the gas solubility data. A correlation is developed from the experimental data in the form on an equation of state. A computer program has been prepared to implement the correlation. 19 refs., 66 figs., 39 tabs.

30758 **(DOE/PC/80526—T9) Alkylation of model metdal cluster systems.** Blackmond, D.G. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). [1988]. Contract FG22-85PC80526. 6p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007591/JAW.

Investigations were undertaken involving cobalt cluster molecules supported on SiO_2. These supported clusters represent a kind of model system in which organic fragements are "adsorbed" onto a well-defined metal framework. The first such system investigated in these studies was prepared wwith ethylidyne tricobalt enneacarbonyl, I. This supported cluster system was allowed to interact with small amounts of an organic alkylating reagent (CD_3)/sub 2]SO{sub 4/, deuterated dimethyl sulfate (DDMS). These interactions were monitored as the system was heated to 373 K, and the formation of gas-pahse organic molecules was observed. Results are discussed. 5 refs., 1 figs., 2 tabs.

30759 (DOE/PC/90504—T5) Configurational diffusion of coal macromolecules: Quarterly progress report, December 15, 1987-March 15, 1988. Guin, J.A.; Curtis, C.W.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1988. Contract FG22-86PC90504. 19p.

Diffusion experiments were conducted with organic compounds to enhance the reliability of experiemntal system design as well as to improve the experimental procedures. From among several organic systems, n-decane (as a solute) and 2-propanol (as a solvent) were selcted. Cencentrations of solutes were analyzed with a differential refractometer. Optimization of operating conditions was also conducted with this new organic system. Special attention was given to the temperature control of the refractometer cell during the optimization process since the refractive index of typical organic solvents is significantly dependent upon temperature change. Experimental procedures for the organic system were the same as with the previously used surcrose-water system; however, some improvements were made. A new sampling method was tried this quarter. However, not enough data were collected to verify the relative advantages of new method. 21 refs., 6 figs., 2 tabs.

30760 (DOE/PC/90526—6) Partial oxidation of light alkanes in transition-metal ion containing zeolites: [Quarterly report, December 14, 1987-March 14, 1988]. Klier, J.P.; Lange, J.P.; Lin, J. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90526. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007116/JAW.

Scattered-wave X-alpha calculations of Cu^{2+} in a trigonal SII zeolite site are in progress using a $(CuSi_6O_{18})$/sup minus/10} cluster. Preliminary results show a calculated valence band width of 8 eV and the 3d copper levels placed in the band gap. Electronic d-d transitions and the charge transfer transition are not predicted satisfactorily in the early stages of the calculations. Adsorption and reaction of O_2 and CH_4 on Co(II)- and Fe(II)- A zeolites are under investigation. O_2 and CH_4 do not adsorb significantly on Co(II)-A at tempertures between 300 and 800K. Hydrated and dehydrated Fe(II)-A zeolites have been prepared and characterized by means of diffuse relfectance spectroscopy. A gas mixture of 0.5 to 1.3% O_2 in CH_4 does not give any detectable product up to 1000K on either Co(II)-A or oxidized Fe(II)-A. 14 refs., 4 figs.

30761 (IC—87/206) Chemical waves in the acetylcholinesterase reaction. Galdzicki, Z.; Kawczynski, A.L. (International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702654/JAW.

In the paper some examples of wave-like behaviour has been shown for open and closed system with acetylocholinesterase reaction. The most effective shortening of the time to complete reaction has been obtained for nonhomogeneous conditions in thermodynamically closed systems. Possible biological applications of this effect have been discussed. (author). 21 refs, 9 figs.

30762 (IC—87/293) Classification of stability for tetrahedral halocomplexes in molten salt mixtures. Akdeniz, Z.; Tosi, M.P.; Wang Li. (International Centre for Theoretical Physics, Trieste (Italy); International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702693/JAW.

We show that a priori atomic parameters (valence electron orbital radii) allow classification of the stability of tetrahedral halocomplexes formed by polyvalent s-p metals in molten mixtures of their halides with alkali halides. The present classification scheme for liquid mixtures parallels previous structural classifications for pure components in solid and molecular phases and is also essentially consistent with a stability criterion based on a Mott picture of a complex as a bound state in a conducting medium. (author). 13 refs, 1 fig., 1 tab.

30763 (INIS-mf—11162) Laser isotope separation - a new class of chemical process. Woodall, K.B.; Mannik, L.; O'Neill, J.A.; Mader, D.L.; Nickerson, S.B.; Robins, J.R.; Bartoszek, F.E.; Gratton, D. (International Atomic Energy Agency, Vienna (Austria)). 1983. 6p. (CONF-8310435—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702342/JAW.

From 33. Canadian chemical engineering conference; Toronto, Canada (2 Oct 1983).

Lasers may soon find several applications in chemical processing. The applications that have attracted the most research funding to date involve isotope separation for the nuclear industry. These isotopes have an unusually high value (≧$1000/kg) compared to bulk chemicals (~$1/kg) and are generally required in very large quantities. In a laser isotope separation process, light is used to convert a separation that is very difficult or even impossible by conventional chemical engineering techniques to one that is readily handled by conventional separation technology. For some isotopes this can result in substantial capital and energy savings. A uranium enrichment process developed at the Lawrence Livermore National Laboratory is the closest to commercialization of the large scale laser isotope separation processes. Of particular interest to the Canadian nuclear industry are the laser separation of deuterium, tritium, zirconium-90 and carbon-14. In this paper, the basic principles behind laser isotope separation are reviewed and brief dscriptions of the more developed processes are given.

30764 (N—88-18664) Calculations of rate constants for the three-body recombination of H_2 in the presence of H_2. Schwenke, D.W. (Eloret Corp., Sunnyvale, CA (USA)). 1988. 50p. (NASA-CR—182548; NAS—1.26:182548). NTIS, PC A03/MF A01.

A new global potential energy hypersurface for $H_3 + H_2$ is constructed and quasiclassical trajectory calculations performed using the resonance complex theory and energy transfer mechanism to estimate the rate of three body recombination over the temperature range 100 to 5000 K. The new potential is a faithful representation of ab initio electron structure calculations, is unchanged under the operation of exchanging H atoms, and reproduces the accurate H_3 potential as one H atom is pulled away. Included in the fitting procedure are geometries expected to be important when one H_2 is near or above the dissociation limit. The dynamics calculations explicitly include the motion of all four atoms and are performed efficiently using a vectorized variable-stepsize integrator. The predicted rate constants are approximately a factor of two smaller than experimental estimates over a broad temperature range.

30765 (ORNL/TM—10639) Stable isotope customer list and summary of shipments:. Tracy, J.G. (comp.). (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 33p.

This compilation is published as an aid to those concerned with the separation and sale of stable isotopes. The information is divided into four sections: alphabetical lists of domestic and foreign customers;alphabetical lists of isotopes and services;alphabetical lists of states and countries;tabulation of the shipments, quantities, and dollars for each isotope and dollars for services divided into domestic, foreign, and DOE project categories. During FY 1987 sales of stable isotope products and services were made to 272 differnt customers, of whom 159 were domestic and 113 were foreign, representing 18 different foreign countries. The total revenue was $3,785,609 of which 12.3% was from sales to DOE project customers, 60.4% was from sales to other domestic customers, and 27.3% was from sales to foreign customers. this represented sales of 189 different stable isotopes plus associated services and was a 16.5% increase over FY 1986.

30766 (SAND—87-1288C) Kinetics of CO oxidation over a deactivated Rh(111) single crystal catalyst. Peden, C.H.F.; Berlowitz, P.J.; Goodman, D.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880602—3).

From 9. international catalysis congress; Calgary, Canada (26 Jun 1988).

Kinetic measurements of the CO oxidation reaction over a model Rh(111) single crystal catalyst, made under highly oxidizing conditions (O_2CO ratios > 301), are reported. Catalytic activity is reduced, but not eliminated, under these conditions as the near-surface region becomes oxidized (probably to Rh_2O_3). However, the reaction occurs by a different mechanism andor involves a different rate-determining step as evidenced by the altered kinetics (activation energy and pressure dependencies) compared to the clean surface under reducing conditions. Post-reaction temperature programmed desorption spectra revealed a new CO_2 feature at temperatures above that required for CO_2 or CO desorption from the clean surface. The presence of this feature and the measured kinetics under oxidizing conditions suggest that the mechanism involves the rate-limited decomposition of a carbonate-like species strongly bound to the oxidized Rh surface. The results further show that the oxide nucleates in islands, giving rise to an intermediate regime in which reaction occurs by the above mechanism on the oxide islands, and by the normal process on the open patches of clean Rh, simultaneously. 14 refs., 7 figs.

30767 **Vibrational frequencies for polyatomic molecules. I. Indole and 2,3-benzofuran spectra and analysis.** Collier, W.B. (IIT Research Institute, National Institute for Petroleum and Energy Research, P. O. Box 2128, Bartlesville, Oklahoma). *Journal of Chemical Physics;* **88**: No. 12, 7295-7306(15 Jun 1988).

A method is presented that can predict the vibrational frequencies of two and three ring polycyclic molecules to an accuracy sufficient for identifying fundamental vibrations. The scaled internal coordinate method of Pulay and co-workers is applied to force constants calculated with the Austin Method 1 semiempirical Hamiltonian. The technique was applied to benzene, furan, and pyrrole to generate a set of scale factors that would allow the a priori prediction of the vibrational spectra for benzofuran and indole. The predicted frequencies had root mean squared deviations of 15—23 cm^{-1} from the observed frequencies. Using the indole and benzofuran predictions, the vibrational assignments were made and ideal gas entropies were calculated. These spectroscopic entropies agreed with the calorimetrically determined entropies.

30768 **Photoionization study of the vinyl radical.** Berkowitz, J.; Mayhew, C.A.; Rus-hacekcic, B. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **88**: No. 12, 7396-7404(15 Jun 1988). Contract W-31-109-ENG-38.

The photoionization spectrum of vinyl radical is reported, from its observed threshold to 1160 A. Two methods of preparation have been employed; (a) the abstraction reaction of F atoms with C_2H_4, and (b) the pyrolysis of divinyl mercury at 1200 K. In both experiments, relatively sharp autoionization structure is observed, and interpreted as a Rydberg series converging to the excited $^3A''$ state of vinyl cation. The analysis leads to an adiabatic ionization energy of ~10.7 eV for this state, with a structure similar to that of vinyl radical but with an increased C—C distance. The observed ionization threshold for the ground state of vinyl cation is 8.59 +- 0.03 eV with the F atom reaction, and 8.43 +- 0.03 eV with the pyrolysis method. The lower value in the latter experiment is interpreted as a hot band. The relatively low value of the photoionization cross section near threshold implies a large geometry change between vinyl radical and ground state vinyl cation. A progression in the in-plane C—H bending vibration is indicated in the photoionization spectrum; it is quite possible that the vibrational 0—0 transition lies one quantum lower than our detected limit. With this bracketed adiabatic ionization potential and the appearance potential of $C_2H^+{}_3$ (C_2H_4), a C—H bond energy in ethylene of 107—110 kcal/mol (0 K) is deduced.

30769 **Theoretical study of structures and energies of acetylene, ethylene, and vinyl radical and cation.** Curtiss, L.A.; Pople, J.A. (Argonne National Laboratory, Chemical Technology Division/Materials Science Program, Argonne, Illinois 60439-4837). *Journal of Chemical Physics;* **88**: No. 12, 7405-7409(15 Jun 1988). Contract W-31-109-ENG-38.

A systematic study of the structures and energies of acetylene, ethylene, and vinyl radical and cation using high levels of ab initio molecular orbital theory, including correlation effects beyond fourth order perturbation theory, is presented. In agreement with previous theoretical studies, the present theory predicts that the bridged form of $C_2H^+{}_3$ is more stable than the classical form with an energy difference of 3.1 kcal/mol (including zero point energies). The bond dissociation energy of C_2H_4,D_0(C—H), is calculated to be 110.2 kcal/mol in agreement with the recent photoionization study of Berkowitz et al. and in significant disagreement with several previous experimental studies. Finally, triplet vinyl cation is studied for the first time and is calculated to be 54.5 kcal/mol higher in energy than the singlet ground state.

30770 **Improved long range potential for $O(^1D)+H_2$.** Walch, S.P.; Harding, L.B. (ELORET Institute, Sunnyvale, California 94087). *Journal of Chemical Physics;* **88**: No. 12, 7653-7661(15 Jun 1988).

Several dynamics studies have indicated that the product isotopic distributions and vibrational energy distributions in the reaction $O(^1D)+H_2$(HD) are very sensitive to the long range interaction of the reactants. In this paper we report an improved calculation of the reactant region of the potential energy surface. In agreement with previous work we find no barrier to edge-on insertion ($^1A'$ ground state water surface), but find a smaller (<0.2 kcal/mol) barrier to collinear addition ($^1\Sigma^+$ surface) than in previous work. The long range potential obtained in the present work most closely resembles the SL3 surface.

30771 **Equation of state of 1-butene shocked to 54 GPa (540 kbar).** Hamilton, D.C.; Mitchell, A.C.; Ree, F.H.; Nellis, W.J. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics;* **88**: No. 12, 7706-7708(15 Jun 1988). Contract W-7405-ENG-48.

Hugoniot equation-of-state data for liquid 1-butene were measured in the shock pressure range 12—54 GPa (120—540 kbar) using a two-stage light-gas gun. The data are compared with previous data for polybutene, a stoichiometrically equivalent liquid with a smaller initial specific volume. The data for both butenes are in agreement with chemical equilibrium calculations which assume that shock-compressed hydrocarbons dissociate and form a two-phase mixture consisting of molecular hydrogen and carbon in a stiff, diamond-like phase.

30772 **Improved potential energy surfaces for the reaction $O(^3P)+H_2 \rightarrow OH+H$.** Joseph, T.; Truhlar, D.G.; Garrett, B.C. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). *Journal of Chemical Physics;* **88**: No. 11, 6982-6990(1 Jun 1988).

We present global $^3A'$ and $^3A''$ potential energy surfaces for the reaction $O(^3P)+H_2 \rightarrow OH+H$ and its isotopic analogs. The new surfaces are based in part on the surface of Lee et al. [J. Chem. Phys. 76, 3563 (1982)] for collinear O—H—H, which is modified to give accurate properties for reactants and products. The potentials for noncollinear O—H—H geometries are based on bending energies of Bowman et al. [J. Chem. Phys. 81, 1739 (1984)] as fit previously and called surface set M2 by two of the authors [B. C. Garrett and D. G. Truhlar, Int. J. Quantum Chem. 29, 1463 (1986)], and the potentials for H—O—H geometries are based on a new interpolation scheme. The new surfaces treat the approach of an O to either end of H_2 equivalently. We used improved canonical variational transition state theory calculations with the least-action ground-state tunneling approximation (ICVT/LAG) to recalibrate the classical barrier height to 13.0 kcal/mol. The ICVT/LAG rate constants calculated using the new surfaces are in excellent agreement with experimental values over the temperature range 298—2400 K. Rate constants and kinetic isotope effects for reactions involving D_2 and HD also are presented and analyzed. Here again, the theoretical results are in very good agreement with experiments.

30773 Variational studies of the importance of triple and quadruple excitations on the barrier height for $F+H_2 \rightarrow FH+H$. Scuseria, G.E.; Schaefer H.F. III. (Center for Computational Quantum Chemistry, School of Chemical Sciences, University of Georgia, Athens, Georgia 30602). *Journal of Chemical Physics;* **88**: No. 11, 7024-7026(1 Jun 1988).

Configuration interaction (CI) methods including all single, double, triple, and quadruple (SDTQ) excitations have been applied with several basis sets to the prediction of the barrier height for the $F+H_2$ reaction.

30774 Dissociative adsorption of alkanes on Ni(100): Comparison with molecular beam results. Sault, A.G.; Goodman, D.W. (Surface Science Division 1134, Sandia National Laboratories, Albuquerque, New Mexico 87185, U.S.A.). *Journal of Chemical Physics;* **88**: No. 11, 7232-7239(1 Jun 1988). Contract AC04-76DP00789.

The dissociative adsorption of ethane, propane, and n-butane on Ni(100) has been investigated at pressures of 0.1—0.001 Torr and temperatures between 350 and 500 K. Activation energies for dissociation are found to be 9.5 kcal/mol for ethane, 3.8 kcal/mol for propane, and 3.1 kcal/mol for n-butane. Dissociative sticking probabilities increase with increasing carbon chain length. Comparison of the present results with the results of a recent molecular beam study of alkane dissociation on Ni(100) show very poor agreement. The sticking probabilities measured here are all orders of magnitude higher than those predicted from the molecular beam study. The discrepancy is attributed to the behavior of alkane molecules with very low normal kinetic energies, which have sticking probabilities below the limits of detection of the beam experiment. C_2H_6 and C_2D_6 have identical dissociative sticking probabilities indicating that quantum tunneling of hydrogen is not an important step in ethane dissociation. Dissociation is proposed to occur via a trapped molecular precursor. The measured alkane dissociation rates compare favorably with hydrogenolysis and steam reforming rates.

30775 Two-bulb thermal separation factors of helium isotopes as a test of recent interatomic potentials. Taylor, W.L. (Mound Laboratory, Monsanto Research Corporation, Miamisburg, Ohio 45342 and Department of Chemistry, University of Cincinnati, Cincinnati, Ohio 45221). *Journal of Chemical Physics;* **88**: No. 11, 7097-7103(1 Jun 1988).

New measurements on the thermal diffusion factor of the $^3He—^4He$ system are reported. The two-bulb method was used to measure α/sub T/ in the temperature range 2.45 to 50 K and employed an improved method to treat the experimentally determined separations. Five recently proposed intermolecular potentials for helium were examined for their ability to predict α/sub T/ through quantum mechanical and classical calculations as compared to all available experimental values in the temperature range ~2 to 900 K.

30776 Nonequilibrium c(2 x 2) island formation during chemisorption: Scaling of spatial correlations and diffracted intensity. Evans, J.W.; Nord, R.S.; Rabaey, J.A. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] B: Condensed Matter;* **37**: No. 15, 8598-8611(15 May 1988). Contract W-7405-ENG-82.

During chemisorption, islands often form in which adspecies have superlattice spacing. Upon meeting, these coalesce if in phase, and form a domain boundary otherwise. Manifestly nonequi- librium island distributions can develop as a result of kinetic limitations, and a metastable saturation state of domain boundaries may, in turn, result. We analyze irreversible cooperative filling models for the formation of c(2 x 2) islands, where island structure is kinetically determined, and extensive coalescence near saturation produces a "percolative" domain structure. We show that the associated dramatic increase in domain size, and fractal domain structure, are not reflected in the spatial pair-correlation or diffracted-intensity behavior. Consequently, we identify quasi-one-dimensional measures of domain size which better reflect correlation-length behavior. These are then used to develop scaling relations for pair correlations and diffracted intensities. A special case of our model describes metastable c(2 x 2)O/Fe(001) formed after exposure of Fe(001) to H_2O.

30777 Interaction of NF_3 with Ru(0001): Order at steps. Walczak, M.M.; Johnson, A.L.; Thiel, P.A.; Madey, T.E. (Surface Science Division, National Bureau of Standards, Gaithersburg, Maryland 20899 and Department of Chemistry and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 675-680(May 1988).

As part of a larger study of small fluorinated molecules on metal and semiconductor surfaces we investigated the adsorption of NF_3 on Ru(0001) using measurements of electron-stimulated desorption ion angular distribution (ESDIAD), low-energy electron diffraction (LEED), thermal desorption spectroscopy, and Auger electron spectroscopy (AES). At 100 K, NF_3 adsorbs with a high sticking probability. Some molecular NF_3 desorbs on heating, with a peak maximum at 200 K. All molecular desorption is complete by 400 K, but AES shows that nitrogen and fluorine remain on the surface up to 1100 K. The LEED pattern of the majority of the surface remains (1 x 1) at all coverages and annealing conditions. At most locations on the Ru(0001) surface (planar regions), ESDIAD is dominated by F^+ emission normal to the surface over the temperature range 100—1100 K. On stepped regions of the surface (near edges and defects) highly directional and intense hexagonal patterns of F^+ emission are observed (200—1100 K). The off-normal beams desorb at 67° +- 3° away from the normal. It appears that most ESDIAD patterns in this system are derived from F or NF/sub x/ (x<3) fragments.

30778 CO oxidation on Pt/SiO_2 and Pd/SiO_2 catalysts: rapid FTIR transient studies. Li, Y.; Boecker, D.; Gonzalez, R.D. (Univ. of Illinois, Chicago (USA)). *Journal of Catalysis;* **110**: No. 2, 319-329(Apr 1988). Contract FG02-86ER13531.

Transient studies on the oxidation of CO have been performed over Pd/SiO_2 and Pt/SiO_2 catalysts using a rapid scan FTIR coupled to a quadrupole mass spectrometer. When a 5% CO(He) mixture was replaced by 5% O_2(He) at 80°C, an induction period of about 110 s was observed before the oxidation reaction was initiated. The length of this induction period was observed to decrease sharply with increasing temperature. When a 5% O_2(He) mixture was replaced by 5% CO(He), the induction periods were almost zero and independent of temperature. The data are explained in terms of a $CO-O_2$ reaction model consisting of CO islands with highly reactive boundaries. The reaction occurs preferentially at the periphery of these islands of reactivity. 28 references.

30779 Quantized colloids produced by dissolution of layered semiconductors in acetonitrile. Peterson, M.W.; Nenadovic, M.T.; Rajh, T.; Herak, R.; Micic, O.I.; Goral, J.P.; Nozik, A.J. (Solar Energy Research Institute, Golden, CO (USA)). *Journal of Physical Chemistry;* **92**: No. 6, 1400-1402(24 Mar 1988).

Small collodial particles (10-35 A) of crystalline MoS_2 and WS_2 exhibiting size quantization effects in their optical absorption spectra are believed to form by simple dissolution of crystalline powder in acetonitrile. This conclusion is supported by electron microscopy, electron diffraction, X-ray diffraction, EDAX, and chemical analyses. The authors speculate that the MoS_2 and WS_2 clusters are formed by cleavage of the van der Waals layers by penetrating solvent molecules, a process related to the well-known formation of colloids from layered clay structures. Preliminary experiments with layered WSe_2 suggest that this material may also form colloids by a similar mechanism.

30780 Multipolar correlations between reactants in crystalline and semiamorphous zeolites. Mandeville, J.B.; Golub, J.; Kozak, J.J. (Univ. of Notre Dame, IN (USA)). *Journal of Physical Chemistry;* **92**: No. 6, 1575-1584(24 Mar 1988).

The authors study the role of multipolar correlations in influencing the efficiency of reaction between a fixed target molecule and a diffusing coreactant in zeolites that exhibit both crystalline and semiamorphous structures. They focus on zeolite A and construct a geometrical model whose framework structure and attendant channel patterns have the same topology as the 26-hedral cavities of type I of this aluminosilicate. They consider reaction partners interacting via (attractiverepulsive) ion-ion, angle-averaged

ion-dipole, and angle-averaged dipole-dipole potentials V(r), and by coupling the theory of finite Markov processes with a lattice version of the Debye-Smoluchowski theory of encounter-controlled reactions, they quantify the differences in the diffusion-controlled rate constant k/sub D/ for reactions taking place in crystalline regions of finite extent (rafts) versus those occurring in crystalline regions surrounded by an amorphous aluminosilicate structure. Calculations based on the model introduced in this paper suggest that much of the marked cation-exchange activity and catalytic activity of fully crystalline zeolites is already captured by semiamorphous zeolites containing raft structures having the spatial extent of those found in recent experimental work by Thomas and Bursill.

30781 **Catalytic oxidation of CO on Rh/SiO_2: a rapid-response fourier transform infrared transient study.** Li, Y.E.; Gonzalez, R.D. (Univ. of Illinois, Chicago (USA)). *Journal of Physical Chemistry;* **92**: No. 6, 1589-1595(24 Mar 1988). Contract FG02-86ER13531.

The catalytic oxidation of CO has been studied over Rh/SiO_2 by using a rapid transient response FTIR-mass spectrometric technique. The reactivity of linearly adsorbed CO was found to be considerably greater than that of the dicarbonyl species at both 85 and 200°C. The frequency of linearly adsorbed CO was observed to undergo a continuous red shift during the duration of the transient, suggesting the formation of a mixed CO-oxygen adlayer. Induction times required for the formation of gas-phase CO_2 were found to be nearly 2 orders of magnitude lower than those observed for Pt/SiO_2 and Pd/SiO_2. Self-sustained $CO-O_2$ oscillations reinforce the greater reactivity of linearly adsorbed CO. H_2-CO-O_2 transient studies also suggest the formation of mixed hydrogen-CO adlayers. Hydrogen was observed to react with the dicarbonyl species to form a hydridocarbonyl species. The CO which is displaced by hydrogen reacts rapidly with chemisorbed oxygen to form CO_2.

30782 **Volumes of aqua ions from measured neutron radial distribution functions.** Hahn, R.L. (Oak Ridge National Lab., TN (USA)). *Journal of Physical Chemistry;* **92**: No. 6, 1668-1675(24 Mar 1988). Contract AC05-84OR21400.

Radial distribution functions (RDF) of aqua ions, obtained in neutron-scattering experiments, are shown to provide an explanation of the results of measurements of a macroscopic property of the ions, the partial molal volume. A simple analysis, based on evidence from the RDF that the aqua ion is spherical, directly gives a value for the volume of the ion's primary hydration sphere. Considering this experimentally derived hydration volume, and the known hydration number of the ion, then leads to a prediction of the ion's partial molal volume that is in good agreement with experiment. A corollary of this analysis is that electrostriction effects are shown to be small in the secondary hydration shell and beyond. The volume of the primary hydration shell of the ion and the average volume of the water molecules in the shell are also calculated; agreement is good between these calculations and the corresponding values derived from measured partial molal volumes. Results are given for 33 different cations. A comparison with published values of total hydration numbers, obtained from transport experiments for lanthanide and actinide ions, is also presented.

30783 **Studies of isotopic exchange between gaseous hydrogen and palladium hydride powder.** Foltz, G.W.; Melius, C.F. (Sandia National Labs., Livermore, CA (USA)). *Journal of Catalysis;* **108**: No. 2, 409-425(Dec 1987).

A gas flow apparatus has been constructed and used to study the isotopic exchange reaction occurring between the solid and gas phases in hydrogen (deuterium) gas flows directed through packed-powder beds of β-phase palladium deuteride (hydride). Spontaneous Raman light scattering is employed to obtain a real-time analysis of the isotopic composition of the gas (H_2, D_2, HD) exiting from the bed. A parametric rate-equation model is described which depicts the time-dependent behavior of the isotopic exchange process. The exchange mechanism is assumed to be rate-limited by processes occurring on the surface of the powder. The fundamental kinetic parameter of the model is the isotopic exchange probability, p, which is the probability that an isotopic exchange event occurs during a collision of a gas-phase atom with the surface. Isotope effects between the gas and solid phases are explicitly included in terms of the isotope separation factor, α. Results of the model are compared with the experimental measurements and, using a literature value of $\alpha = 2.4$, good agreement is obtained for $p \approx 10^{-7}$. In view of the importance of the isotope effects in the hydrogen/palladium system and the range of a values reported for the β-phase in the literature, the sensitivity of the model results to a variation in the value of α is examined.

30784 **Oxidation-reduction treatment of rhodium supported on nonporous silica spheres.** Chakraborti, S.; Datye, A.K.; Long, N.J. (Univ. of New Mexico, Albuquerque (USA)). *Journal of Catalysis;* **108**: No. 2, 444-451(Dec 1987).

The structure of Rh crystallites subjected to oxidation-reduction treatment has been investigated by high-resolution transmission electron microscopy. The Rh was supported on 130-nm nonporous silica spheres so that the three-dimensional structure of the metal crystallites could be readily observed. After oxidation at 823 K and subsequent reduction at 473 K, the particles show images characterized by a lower contrast at the center. The edge-on views confirm that the particles are not toroidal but near spherical with a void at the center. This morphology is a result of the density difference between Rh metal and its oxide. The resulting metal crystallites are polycrystalline and exhibit twinning and considerable strain. These structures, however, are unstable, and annealing in the electron beam seems to cause the crystallites to revert to a single crystal morphology. 15 references.

30785 **Catalysis over molybdenum carbides and nitrides. I. Catalyst characterization.** Ranhotra, G.S.; Haddix, G.W.; Bell, A.T.; Reimer, J.A. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **108**: No. 1, 24-39(Nov 1987). Contract AC03-76SF00098.

The hcp and fcc phases of Mo_2C and the fcc phase of Mo_2N have been prepared and characterized. Mo_2C (hcp) was produced by carburization of metallic Mo. The resulting material is polycrystalline, has a BET surface area of 10-30 m^2/g, and pores 30 A in diameter. Mo_2N (fcc) is obtained by NH_3 reduction of MoO_3. The nitride has a high degree of crystallinity, a BET surface area of about 180 m^2/g, and pores about 17 A in diameter. The fcc phase of Mo_2C is produced by exposing Mo_2N to a CH_4/H_2 mixture. This results in a substitution of C for N atoms in the lattice without major changes in the BET area of pore diameter. The preparation of both Mo_2C (hcp) and Mo_2C (fcc) is accompanied by the deposition of free carbon. Selective removal of the free carbon without concurrent removal of lattice carbon cannot be achieved. Air exposure of the carbides does reduce the inventory of free carbon, but at the expense of introducing oxygen into the carbide lattice. The dissolved oxygen cannot be removed by H_2 reduction without removal of lattice carbon. It is possible, though, to remove oxygen from the near-surface region of the carbide particles by pretreating the air-exposed carbide powder in a CH_4/H_2 mixture at 623 K. Use of the carbide and nitride catalysts for CO hydrogenation and C_2H_6 hydrogenolysis causes further changes in the catalyst composition. CO hydrogenation can deposit free carbon and introduces oxygen into the lattice of the catalyst particles. C_2H_6 hydrogenolysis is very efficient in removing oxygen dissolved in the catalyst lattice.

30786 **Microdiffraction study of gold-ruthenium catalyst particles.** Cowley, J.M.; Plano, R.J. (Arizona State Univ., Tempe (USA)). *Journal of Catalysis;* **108**: No. 1, 199-207(Nov 1987). Contract FG02-86ER45228.

A dedicated scanning transmission electron microscopy (STEM) instrument has been used to obtain microdiffraction patterns from metal particles of diameter in the range 1-3 nm. From about 200 good, clear patterns from particles in gold-ruthenium catalysts on magnesium oxide and silica supports, most could be identified as coming from MgO, Au, or Ru in their known structural forms. About 30 patterns could clearly not be attributed to any known structure. For these patterns, agreement could be found with the assumption of either two-dimensional hexagonal rafts of atoms with periodicities of about 0.25 nm or a faulted body-centered cubic structure with unit cell edge about 0.295 nm. Each of these possibilities involves an interatomic distance 5 to 10% smaller than the bulk of Ru-Ru value. Evidence from high-resolution electron microscopy tends to support the BCC structure. No clear evi-

dence could be found for any association of Au and Ru atoms. 16 references.

30787 **Use of TPD and TPR to study subsurface mobility: diffusion of oxygen in Mo_2C.** Leary, K.J.; Michaels, J.N.; Stacy, A.M. (Univ. of California, Berkeley (USA)). *Journal of Catalysis;* **107**: No. 2, 393-406(Oct 1987). Contract AC03-76SF00098.

The application of temperature-programmed desorption (TPD) and reduction (TPR) to the study of subsurface diffusion in high surface area powders is considered. Although subsurface diffusion may be important in catalysis, relatively few techniques have been developed to study this process in high surface area materials. Since oxygen is very mobile in Mo_2C, the authors chose to study Mo_2C to illustrate how TPD and TPR can be used to study subsurface diffusion. In particular, the effect of the Mo:C ratio on the oxygen mobility is investigated. The TPR spectrum of oxygen adsorbed on Mo_2C contains two water peaks, a narrow one at 479 K, and a second much broader peak near 573 K. While the first peak is produced by surface oxygen, the second peak is caused by oxygen that diffuses into the subsurface region of the catalyst during the temperature ramp. As the surface becomes depleted at higher temperatures, this oxygen diffuses back to the surface, reacts with the gas-phase hydrogen, and desorbs as water. For carbon-deficient catalysts the two peaks merge into one asymmetric peak at 510 K with a tail extending to higher temperatures. A model is presented which gives a semiquantitative description of the effect of subsurface diffusion on TPD and TPR spectra. The model is able to explain the changes in the spectrum caused by varying the Mo:C ratio; the data cannot be explained by a model which assumes that the two peaks are due to two distinct adsorption sites on the surface. An important result of this work is that in cases in which a peak produced by subsurface diffusion is resolved, the activation energy for diffusion in the subsurface can be measured. 26 references.

30788 **Dispersion of silica-supported copper catalysts determined by NMR of ^{63}Cu.** King, T.S.; Goretzke, W.J.; Gerstein, B.C. (Iowa State Univ., Ames (USA)). *Journal of Catalysis;* **107**: No. 2, 583-586(Oct 1987). Contract W-7405-ENG-82.

Determining the dispersion of supported copper catalysts is difficult because of the inertness of copper metal. Copper does not readily dissociate and adsorb hydrogen, and therefore, the traditional method of hydrogen chemisorption is not applicable in this case. The most widely used method of determining dispersion (or surface area) of supported and unsupported copper has been the reaction of copper surface atoms with nitrous oxide. The authors report here the use of solid state NMR of ^{63}Cu in silica-supported copper catalysts as a new, independent method for determining copper dispersion. This method has an advantage over the nitrous oxide method in that it need not assume a stoichiometry for a reaction. The results are shown to agree with those obtained from the use of nitrous oxide when the stoichiometric ratio of copper to adsorbed oxygen in the above reaction is two. 16 references.

30789 **Spectroscopic characterization of TiO_2/Al_2O_3 and Co/Al_2O_3-TiO_2 catalysts.** Stranick, M.A.; Houalla, M.; Hercules, D.M. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **106**: No. 2, 362-368(Aug 1987). Contract AC02-79ER10485.

X-ray photoelectron spectroscopy (ESCA or XPS), laser Raman spectroscopy (LRS), and X-ray diffraction (XRD) have been used to characterize the dispersion and chemical state of a series of TiO_2/Al_2O_3 carriers and a series of 3% Co/Al_2O_3-TiO_2 catalysts. It was found that titania is well dispersed on alumina for Ti loadings less than 14 wt%. The formation of a TiO_2:Al_2O_3 surface phase occurred for carriers in the 1 to 6 wt% Ti range. Formation of anatase occurred, in addition to the TiO_2:Al_2O_3 surface phase, at loadings in excess of 6 wt% Ti, with the amount of anatase increasing with increasing titania loading. ESCA data indicate that the dispersion of cobalt supported on the titania-modified alumina carriers increased with increasing titania loading. XRD and LRS results show that the increase in dispersion can, in part, be ascribed to the formation of a surface cobalt phase at the detriment of the Co_3O_4 phase. 29 references.

30790 **Alloy formation in Pt-Sn-alumina catalysts: in situ X-ray diffraction study.** Srinivasan, R.; De Angelis, R.J.; Davis, B.H. (Univ. of Kentucky, Lexington (USA)). *Journal of Catalysis;* **106**: No. 2, 449-457(Aug 1987). Contract AS05-82ER12098.

Changes in Pt-Sn-alumina catalysts, prepared from the $(Pt_3Sn_8Cl_{20})^{2-}$ complex, during reduction in flowing hydrogen were followed by in situ x-ray diffraction (XRD). For high metal loading (ca. 5% Pt) evidence was found for both Pt-Sn and Pt phases: other Pt-Sn phases, such as Pt_3Sn. $PtSn_2$, and $PtSn_4$, were not observed. Metallic Pt was detected for a 0.6 wt% Pt-Al_2O_3 catalyst but only a Pt-Sn alloy was observed for a 0.6 wt% Pt catalyst containing Sn. In situ XRD studies therefore support alloy formation with a stoichiometry of Pt:Sn = 1:1; the Sn in excess of that needed to form this alloy is present in an X-ray amorphous form. 42 references.

30791 **ENDOR of perylene radicals adsorbed on alumina and silica-alumina powders. I. The ring protons.** Clarkson, R.B.; Belford, R.L.; Rothenberger, K.S.; Crookham, H.C. (Univ. of Illinois, Urbana (USA)). *Journal of Catalysis;* **106**: No. 2, 500-511(Aug 1987). Contract FG22-84PC70782.

Complex electron-nuclear double-resonance (ENDOR) spectra were obtained from the radicals formed on activated alumina and silica-alumina powders exposed to solutions of perylene in benzene. Use of deuterated solvent to suppress spectral contributions from proton matrix effects enabled more detailed analysis of resonances associated with hyperfine interactions of ring protons of the perylene radical ion. A model of isotropic Zeeman interactions (g) and very anisotropic hyperfine splittings (A) is supported by multifrequency EPR measurements and ENDOR simulations devised for this work. All three proton hyperfine interactions of the perylene radical ion were resolved and the absolute values of the principal elements of the hyperfine coupling matrices were obtained. The fact that these values for radicals formed on alumina and silica-alumina were nearly identical implies that the same radical species forms on both surfaces. These findings are discussed and the radical is assigned as the cation. 27 references.

30792 **Studies on molybdena-alumina catalysts. XII. MoS_2 surface coverage from CO_2 adsorption.** Zmierczak, W.; Qader, Q.; Massoth, F.E. (Univ. of Utah, Salt Lake City (USA)). *Journal of Catalysis;* **106**: No. 1, 65-72(Jul 1987). Contract FG02-84ER13277.

Adsorption of CO_2 on a number of sulfided Mo/Al_2O_3 catalysts of different Mo contents and Al_2O_3 supports was made by a pulse technique. Uptakes on the catalysts were lower than on their respective supports, from which the surface coverage of the Al_2O_3 by the MoS_2 phase was determined, since CO_2 did not adsorb on MoS_2. It was found that supports calcined up to 500°C and for Mo loadings up to 8%, the MoS_2 phase was present as a monomolecular layer. However, supports calcined at higher temperatures showed evidence of multilayers of MoS_2. The results are consistent with a model in which the MoS_2 clusters are oriented flatwise to the support. The lower coverage found in monolayer catalysts in the sulfide state compared to the oxide state is attributed to contraction of the coverage per Mo atom rather than to formation of multilayers. ESCA results on multilayer oxide catalysts showed qualitative correlation with calculated average numbers of multilayers present. 20 references.

30793 **Quantitative Raman characterization of Mo/TiO_2 catalysts.** Quincy, R.B.; Houalla, M.; Hercules, D.M. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **106**: No. 1, 85-92(Jul 1987). Contract AC02-79ER10485.

Two molybdenum species (i.e., Mo interaction species and MoO_3) are identified and quantitated by Raman spectroscopy for a series of Mo/TiO_2 catalysts. The Mo interaction species is shown to increase with Mo loading up to 6 wt% MoO_3 and to level off at higher Mo loadings. MoO_3 is detected at 7.5 wt% MoO_3/TiO_2 and shown to increase linearly with further Mo addition. The molybdenum speciation determined from Raman data is shown to correlate with ESCA and X-ray diffraction measurements. 33 references.

30794 **Nuclear magnetic resonance probe for in situ studies of adsorbed species on catalysts.** Haddix, G.W.; Reimer, J.A.; Bell, A.T. (Lawrence Berkeley Lab., CA (USA)). *Journal of Catalysis;* **106**: No. 1, 111-115(Jul 1987). Contract AC03-76SF00098.

The use of nuclear magnetic resonance (NMR) spectroscopy to study adsorbed species on catalyst surfaces has grown rapidly in the last 10 years. To date, most investigators have prepared their samples ex situ in a sealed tube that can be placed in the coil of the NMR probe. While simple, this technique is inconvenient for studying the effects of adsorbate pressure and adsorption temperature. A more flexible arrangement involves sample cells that can be attached to a volumetric adsorption apparatus, or gas feed system. Using this approach, it is possible to alternate static adsorption and NMR measurements, or to do batch reactions. In the present paper the authors describe a double resonance NMR probe with a built-in microreactor that can be heated or cooled. This design permits investigations of steady-state catalytic reactions, as well as static adsorption experiments.

30795 **Molybdenum carbide catalysts. I. Synthesis of unsupported powders.** Lee, J.S.; Oyama, S.T.; Boudart, M. (Stanford Univ., CA (USA)). *Journal of Catalysis;* **106**: No. 1, 125-133(Jul 1987). Contract AS03-79ER10502.

Temperature-programmed reaction between MoO_3 of low specific surface area S/sub g/ and a CH_4H_2 mixture produces unsupported powders of hexagonal Mo_2C with S/sub g/ from 50 to 100 m^2g and CO uptake number density of up to 5.0×10^{14} cm^{-2}. Depending on the preparation conditions, this material can be synthesized with a surface free of contamination by noncarbidic carbon (Mo_2C-I) or with a surface completely covered by polymeric carbon layers (C-Mo_2C). For the latter case a method of treatment with dihydrogen was developed that removes the carbon contamination to create an active carbide surface (Mo_2C-II). 21 references.

30796 **Activated chemisorption of hydrogen on supported ruthenium. I. Influence of adsorbed chlorine on accurate surface area measurements.** Lu, K.; Tatarchuk, B.J. (Auburn Univ., AL (USA)). *Journal of Catalysis;* **106**: No. 1, 166-175(Jul 1987). Contract AC22-83PC60044.

Irreversible hydrogen adsorption onto Ru/Al_2O_3 catalysts prepared from $RuCl_3$ occurs with apparent activation energies as high as 16 kcal/mole at half-saturation coverage, whereas little or no apparent activation energy barriers are encountered over catalysts prepared in the absence of chlorine from $Ru_3(CO)_{12}$. Adsorption uptakes measured at 298 K on chlorine-containing specimens can be as little as one-half the value measured at 373 K even though 24-h equilibration times are used. Addition of low chlorine levels to chlorine-free precursors of 2.8-nm diameter indicates that the first chlorine adatoms to adsorb produce about six activated adsorption sites per chlorine adatom. Further chlorine addition to 2.8-nm crystallites poisons a maximum of 20% of the available hydrogen adsorption sites while ca. 38% of the remaining sites become so activated that they can be populated only after adsorption at ca. 373 K. Additional studies demonstrate that the above-noted effects cannot be attributed to (i) titration of surface oxygen, (ii) incomplete reduction of the catalyst, or (iii) hydrogen spillover. Rather, it appears that the presence of electronegative adatoms decreases electron density at nearby ruthenium atoms thereby inhibiting electron donation to, and dissociative chemisorption of, incoming hydrogen molecules. Observations from these studies suggest that hydrogen adsorption measurements may severely underestimate the number of surface ruthenium atoms. The magnitude of such errors increase at lower adsorption temperatures and at higher chlorine coverages. 29 references.

30797 **Activated chemisorption of hydrogen on supported ruthenium. II. Effects of crystallite size and adsorbed chlorine on accurate surface area measurements.** Lu, K.; Tatarchuk, B.J. (Auburn Univ., AL (USA)). *Journal of Catalysis;* **106**: No. 1, 176-187(Jul 1987). Contract AC22-83PC60044.

A crystallite size effect has been observed during the activated adsorption of hydrogen on supported ruthenium catalysts. This effect does not occur in the absence of adsorbed chlorine and is increasingly more pronounced as metal dispersion is increased. Activation energies for adsorption, at constant hydrogen coverage, may be as high as 16 kcal/mole and have been measured utilizing (i) Al_2O_3 and SiO_2 support materials, (ii) crystallites which range in size from 2.6 to 22.0 nm, and (iii) surface chlorine coverages which vary from 0.01 to 0.35 of the number of surface ruthenium atoms. Results of these studies suggest that preferential adsorption of chlorine atoms at high coordination sites reduces electron density at adjacent low coordination sites, thereby increasing the activation energy barrier for electron donation to, and dissociative chemisorption of, incoming hydrogen molecules. While this effect may be viewed as primarily electronic in origin, a structure-sensitive (i.e., crystallite size-dependent) mechanism has been proposed to account for the observed adsorption behavior based on the number of high coordination-chlorine adsorption sites in close proximity to low coordination-hydrogen adsorption sites. Activated adsorption sites, attributed to the above-noted mechanism, can be responsible for a greater than two-fold underestimation of the number of surface ruthenium atoms measured by irreversible hydrogen adsorption at 298 K. Significant differences in adsorption behavior between silica- and alumina-supported crystallites of equal dispersion also suggest that deliberate addition of chlorine adatoms may provide a sensitive probe for discriminating differences in crystallite shape and surface texture. 19 references.

30798 **Effect of the isoelectric point on the adsorption of molybdates on fluoride-modified aluminas.** Mulcahy, F.M.; Houalla, M.; Hercules, D.M. (Univ. of Pittsburgh, PA (USA)). *Journal of Catalysis;* **106**: No. 1, 210-215(Jul 1987). Contract AC02-79ER10485.

The isoelectric point (IEP) of γ-alumina was modified by the addition of various amounts of fluoride. The modified aluminas were used as supports for molybdenum catalysts prepared by equilibrium adsorption at pH = 6.5. Also, the adsorption of molybdate on supports containing various amounts of fluoride was studied as a function of pH. The amount of molybdenum adsorbed on the fluoride-modified aluminas was found to decrease the IEP of the carrier decreased. An electrostatic model is used to interpret the results. 9 references.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 30389, 30390, 30393

30799 **(AD-A—189378/3/XAB) Constrasting conductance/viscosity relations in liquid states of vitreous and polymer solid electrolytes. Technical report.** McLin, M.; Angell, C.A. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). Nov 1987. 18p. (TR—14). NTIS, PC A03/MF A01.

In order to contrast conductivity mechanisms in fast-ion glassy and rubbery polymer electrolytes, the liquid states of two prototypical cases were studied. Viscosity and conductivity measurements were performed on molten (as opposed to glassy) (AgCl) 0.35 (Ag(I)) 0.45 (CsCl) 0.20 and on solutions of sodium triflate in low-molecular-weight PPG (as opposed to high mw, 1,000,000 rubbery solid PPG - called PPO). Both types of system show non-Arrhenius viscosity with divergent behavior near T(g). The energetics of the conductivity processes, however, are very different. This is emphasized by reduced temperature scale (T/T(g)) plotting of (temperature-dependent) activation energies. For the polymer salt systems, as for normal molten-salt systems and aqueous solutions, conductance and viscosity energetics are comparable - the processes are coupled. Reduced-temperature plots of polymer solutions and glass-forming aqueous-solution data show the relative importance of T(g) and ion-association factors in limiting polymer-electrolyte performance.

30800 **(LBL—24442) Potential induced structural transformations of the Au(100) and Au(111) surfaces.** Ross, P.N. Jr. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 7p. (CONF-880549—1).

From Electrochemical Society spring meeting; Atlanta, GA, USA (15 May 1988).

Work has concentrated on the use of emersed Au(111) films evaporated on cleaved mica, analogous to the Ag(111) films used in other GID studies. We have studied these Au(111) films using the dame LEEDUHV apparatus as in our previous studies of Au(111)

crystals, and supplemented these with GID (grazing incidence x-ray diffraction) analysis of emersed Au(111) films with thru-air transfer to a two-circle diffractometer on beamline VI at SSRL. In-situ studies using GID with a new four-circle diffractometer on beamline VI ar SSRL are scheduled for the spring running or SSRL. The ex-situ analyses by LEED and GID of the (1 {times} 1) {yield} (5 {times} 20) transformation were in reasonable agreement with one another, and the results qualitatively similar to the results for Au(100), i.e. the reconstructed ($\sqrt{}$ 3 {times} 22) surface was observed only with emersion from K^+ and Cs^+ electrolytes, and not from pure acids, but the ($\sqrt{}$ 3 {times} 22) was observed at much more anodic potentials of emersion than for the)100)-(5 {times} 20). Both of the reconstructions on Au(111) and (100) represent a contraction of the Au-Au bond length for the Au-Au bond length for the Au atoms in surface layer, 4% and 6.5%. Anions on the emersed surface stabilize the (1 {times} 1) structure and possibly cause an as yet unobserved expansion in the Au-Au surface atom bond length. Charge density waves (solitons← produced by ion (cation or anion) adsorption appear to be the driving force for the (111)-(1 {times} 1) $\rightleftharpoons$ ($\sqrt{}$ 3 {times} 22) and (100)-(1 {times} 1) {rightleftharpoons} (5 {times} 20) surface phase transitions.

30801 (LBL—24822) Electrode films of porous agarose: The effects of physical structure on electron transport processes. Moran, K.D. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 162p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88007366/JAW.

Potential use of chemically modified electrodes in electrocatalysis has stimulated interest in creation and characterization of electrode films for reagent immobilization. We have created two highly porous electrocatalyst support matrices, with high rates of electron transport. Both are based on immobilization of reagents in agarose gel. In one case, Nafion was impregnated into agarose gel films. Diffusion of methyl viologen in Nafionagarose matrices are higher than in Nafion. In Nafion, the diffusion coefficient decreases with increasing methyl viologen concentration, while in Nafionagarose, the opposite dependence is observed. The faster rate of electron transport in Nafionagarose films is related to the heterogeneous structure and the coupling of the diffusion pathways. In the second application of agarose gels as an electrode coating material, agarose hydroxyl groups were activated in 1,1'carbonyldiimidazole and subsequently reacted with amine derivatives of electroactive mediators. Electron transport between the electroactive sites in the gel is very rapid (on the order of 10^{-7} cm^2s. Interpreting the data in light of the Dahms-Ruff description of electron transport shows that the rate of electron transport through both ferrocene and viologen derivatized gels is limited by the rate of electron self-exchange of the species. 22 figs., 15 tabs.

4005 Photochemistry

30802 (DOE/ER/13504—2) Applications of photoinduced electron transfer and hydrogen abstraction reactions to chemical and electrochemical conversion processes: Progress report, April 16, 1987. (Rochester Univ., NY (USA). Dept. of Chemistry). [1987]. Contract FG02-86ER13504. 5p. NTIS, PC A02; 3; GPO Dep. Order Number DE88007441/JAW.

Our work during the present project period has advanced along each of the lines outlined in the original proposal. One major focus of our research continues to be astudy of light-induced electron transfer reactions with special interest on those processes which culminate in net two or more electron redox chemistry. Much of our work has involved light-absorbing electron acceptors which can be activated by near ultraviolet or visible light. We have made a great deal of progress during the past year in developing and understanding photochemical dehydrofragmentation reactions of potential electron donors which are themselves transparent to wavelengths absorbed by the acceptors.

30803 Determination of the ionization threshold of azulene in hydrocarbon liquids by multiphoton ionization. Faidas, H.; Christophorou, L.G. (Atomic, Molecular, and High Voltage Physics Group, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6122). *Journal of Chemical Physics;* 88: No. 12, 8010-8011(15 Jun 1988). Contract AC05-84OR21400.

The ionization threshold of azulene is determined in a number of nonpo liquids, using a new multiphoton ionization technique. The nature of the various multiphoton ionization mechanisms are discussed.(AIP)

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 30115, 30753, 31229, 31237

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 30953, 31198, 31199, 31207

30804 (AD-A—189764/4/XAB) Review of radon emanation and mobilization in minerals and rocks. Final report. Cameron, C.P. (University of Southern Mississippi, Hattiesburg (USA). Dept. of Geology). Sep 1987. 49p. NTIS, PC A03/MF A01.

Determination of the natural-radiation environment should receive high priority during screening, characterization, construction, and operational phases of underground facilities. Radon-222, and Radon-220 (Thoron) occur widely throughout the earth's crust, and in terms of human exposure to natural radiation, the best materials for siting deep excavations are limestones, gabbros, and serpentinites (and their metamorphic equivalents) all of which have low levels of uranium concentration and radon escape. Radon daughters are natural radioactive substances whose concentration may be anomalously high in parts of some deep excavations, particularly in granitic rocks. Anomalous accumulations of radioactive minerals generate radon gas above-background. In deep unlined excavations, radon gas can contaminate the air as it is easily absorbed onto dust particles, soot (from motors), and water droplets as the gas emanates from rock faces, broken rock, faults, joints, fractures, and underground waters entering the excavation. The geochemical behavior of daughter isotopes in the radioactive-decay series of uranium and thorium is generally not well understood. Considerable work is needed on ground-water geochemistry and the geochemical behavior of radon precursors in relation to anomalous underground concentrations of radon.

30805 (AERE-R—12487) Literature survey of the organic speciation of radionuclides. Sparkes, S.T.; Sanders, T.W.; Long, S.E. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Sep 1987. 25p. H.M. Stationery Office, London, price Pound 4.00.

Literature regarding the prevalance of the organic speciation of radionuclides has been critically reviewed. For nuclides likely to be of interest in radiological protection little information regarding organic speciation has been found. Evidence for enhanced uptake of cobalt incorporated into cyanocobalamin has been reported by several authors. Studies of stable elements have indicated that organic speciation may be significant in uptake, particularly in the gastrointestinal tract. It is concluded that in view of the lack of published information on this highly significant area further study of the organic speciation of radionuclides is required, with both qualitative and quantitative determination of the chemical forms present.

30806 (Juel—2119) Hot reactions in the systems $^{11}CH_2O(l)$, $^{11}CH_2O$-$NH_3(l)$ and $^{13}NH_2O(g)$. Schmitz, G.; Nebeling, B.; Roessler, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie 1 -Nuklearchemie). Mar 1987. 76p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753567/JAW.

The chemical reactions of hot ^{11}C with liquid water and a water ammonia mixture of mass ratio 3:1 and of ^{13}N with water vapour were studied at T = 295 K. ^{11}C was generated by the nuclear processes $^{16}O(p,\alpha,pn)^{11}C$ and $^{14}N(p,\alpha)^{11}C$. ^{13}N was produced via the $^{16}O(p,\alpha)^{13}N$ nuclear reaction. The proton radiation dose was varied from D/sup */ = $2.8x10^{-3}$ to 0.28 eV per target molecule for the system $^{11}CH_3O(l)$, from D* = 2.2 to 32 eV for the system $^{11}CH_3O\text{-}NH_3(l)$ and from D* = 0.13 to 6.2 eV for the system $^{13}NH_3O(g)$, in order to follow radiolytic changes of the reaction products. Products of the system $^{11}CH_3O(l)$ were $^{11}CO_2$ (98-100% radiochemical yield) and ^{11}CO (max. 1.5%). For the system $^{11}CH_3O\text{-}NH_3(l)$ six products ($^{11}CO_2$, ^{11}CO, $H^{11}COOH$, $^{11}CH_3O$, $^{11}CH_3OH$ and $^{11}CH_4$) were observed at radiation doses up to D* = 32 eV. In the system $^{13}NH_3O(g)$ five products were detected: $^{13}NO_2$, ^{13}NO, ^{13}NN, ^{13}NNO and some $^{13}NH_3$. ^{13}NO is the main product at lowest doses with radiochemical yields exceeding 45%. With increasing radiolysis ^{13}NO is changed to $^{13}NO_2$. At higher doses ^{13}NN becomes the main product. The system $^{11}CH_3O\text{-}NH_3(l)$ seems to bear some importance for the production of labelled precursors for the synthesis of radiopharmaceuticals. The interesting products $^{11}CH_3O$ and $^{11}CH_3OH$ are still formed under intensive irradiation which is necessary for the production of high radioactivities for nuclear medical application.

30807 **(KFK—4362) Chemistry of technetium in the PUREX process.** Boukis, N. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie; Heidelberg Univ. (Germany, F.R.). Fakultaet fuer Chemie). Jan 1988. 172p. (In German). (PWA—73/85). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753583/JAW.

The behaviour of the element technetium in the PUREX-process has been investigated. Pertechnetate ion is reduced to tetravalent technetium, TcO^{2+}, by hydrazine in acidic aqueous solution. The autocatalytic reduction shows the rate constant k_3 = 11 L x M^{-1} x min^{-1}. The rate constant for the initial reduction is k_1 = $3.3x10^{-4}$ L^3 x M^{-2} x min^{-1}. After the almost quantitative reduction of Tc(VII) a complicated oxidation of the hydrazine begins accompanied by the slow reoxidation of the tetravalent technetium to TcO_4. A large amount of tetravalent technetium remains stable in the acidic solution for several years. The TcO^{2+} ion was identified by absorption spectroscopy and EPR techniques. Its behaviour was studied under experimental conditions of the PUREX-process.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 29893, 30772, 31442

30808 **(AD-A—189432/8/XAB) Measurement of rate constants of elementary gas reactions of importance to upper atmosphere and combustion systems. Final report, 1 March 1985-31 August 1987.** Golde, M.F. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). 31 Oct 1987. 22p. NTIS, PC A03/MF A01.

Important elementary gas-phase reactions were studied by the discharge flow technique, utilizing laser-induced fluorescence to detect radical species and mass spectrometry to monitor stable reaction products. Both rate constants and reaction products were determined. The H-abstraction reactions of F atoms and of OH radicals with CH_3OH favor different reaction channels: the former yields predominantly methoxy radicals (CH_3O), whereas the latter strongly favors hydroxymethyl (CH_2OH). The reaction of OH with CH_3OH shows a large kinetic isotope effect for this channel. The kinetics of CH_3O with NO resemble those of CH_3O with NO_2 studied previously in this lab, namely a weak positive pressure dependence and a strong inverse temperature dependence and a strong inverse temperature dependence of the second order rate coefficient. Analysis of the rate data together with direct detection of reaction products have established that atom transfer to yield HNO + CH_2O is the major channel at low pressures. A brief study of the reaction of NH_2 with NO has shown that OH production is a minor channel, with a branching fraction of < or = 0.04.

30809 **(AD-A—189813/9/XAB) Numerical simulation of turbulent flames using vortex methods. Annual report No. 3, 1 September 1986-31 August 1987.** Ghoniem, A.F. (Massachusetts Inst. of Tech., Cambridge (USA)). 5 Oct 1987. 126p. NTIS, PC A07/MF A01.

Th vortex-element and transport-element methods are developed for numerical simulation of the Navier-Stokes equations and the energy and species conservation equations, accurate simulation of the governing equations at high Reynolds and Peclet numbers, without resorting to turbulence modeling. Finite-rate chemical reactions, finite compressibility and finite heat-release rates are also considered in the formulations of the numerical schemes. To validate these methods, solutions are being obtained for reacting shear layers, both homogenous and heterogeneous, under various idealizations, and comparing the numerical results with experimental data. The solutions are also analyzed to investigate the mechanisms of turbulence combustion interactions.

30810 **(N—88-19652) Thermal cracking and variable properties effects on free boundary layer diffusion flames.** Matage, T.G. (California Univ., Berkeley (USA)). Mar 1988. 45p. (NBS-GCR—88-542). NTIS, PC A03/MF A01.

An analytical model for a free convective boundary layer flame is presented and compared with experimental results. The analytical model will add two new features to the solution presented in order to improve agreement with experimental data. It is proposed that the fuel undergoes endothermic decomposition (cracking) before reaching the flame. The effect of cracking on the free convective diffusion flame is explored by the use of modified Shvab Zeldovich variables which model both the flame reaction and the cracking reaction. The second addition to the solution is the use of a temperature dependent density-viscosity function which allows the ambient viscosity to be determined by ambient conditions. In order to match the location of the theoretical flame with that of the experimental flame, previous studies have adjusted the ambient viscosity to non-ambient values. By using the temperature dependent density-viscosity function, the analytical model accurately predicts the location of the flame using the ambient value of viscosity.

30811 **Modeling of shock-induced chemical reactions in powder mixtures.** Horie, Y.; Kipp, M.E. (North Carolina State University, Raleigh, North Carolina 27695). *Journal of Applied Physics;* **63**: No. 12, 5718-5727(15 Jun 1988).

Chemical reactions in inorganic powder mixtures under high-pressure shock wave loading are described by two mathematical models, one homogeneous and the other heterogeneous. The models are formulated based upon existing results of observations on post-shock samples of Al-Ni, Al-Ti, and $ZnO\text{-}Fe_2O_3$ mixtures. Two mechanisms were isolated for the development of the initial models: (1) the creation of a nonequilibrium mixture by dynamic mass mixing, and (2) ensuing chemical reactions. The homogeneous model was evaluated under shock conditions using a one-dimensional wave propagation code, and suggested requisite conditions for the thermal excursion of localized reactions: a localized initial peak temperature of 1000—2000 K and reaction time constants of 1 μs or less. Calculations indicate that reactions occur while the sample is under shock loading, consistent with observations of post-shock samples.

42 ENGINEERING

REFER ALSO TO CITATION(S) 31012

30812 **(BNL—40986) Massachusetts Institute of Technology School of Chemical Engineering Practice, Brookhaven station: Summary of projects, 1983-1986.** (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 55p.

The MIT Graduate School of Chemical Engineering Practice stresses engineering problem solving. The Practice School program, as it is commonly called, develops in a unique and particularly effective way the student's ability to apply fundamentals to problems in the chemical industry and thus accelerates one's professional development. The themes of atomization, emthanol production

and utilization, hydrogen production and compression, localized electrochemical corrosion and biochemical engineering reflect some of the major programs at the Laboratory. The titles of all the projects are listed in chronological order in the index at the end of this document. Brief summaries are presented for each project with related projects grouped together.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 29901, 30001, 30082, 30228, 30589, 30940, 30941, 30944, 31943

30813 **(AD-A—189747/9/XAB) Department of Defense Superconductivity Research and Development (DSRD) options. A study of possible directions for exploitation of superconductivity in military applications.** (Office of the Deputy Under Secretary of Defense (Research and Advanced Technology/Rlm), Washington, DC (USA)). Jul 1987. 126p. NTIS, PC A07/MF A01.

Although the technology associated with traditional low-temperature superconductivity (LTS) materials is relatively mature, the scientific foundations for the newly discovered high temperature superconducting (HTS) materials are in a more-rudimentary state, and the engineering parameters required for definition of possible realms of exploration are largely unknown. Within the limitations imposed by these unknown factors, this document sets forth a menu for a five-year Department of Defense Superconductivity Research and Development (DSRD) program. The goal of this program is to assure that the potential of HTS is realized at the earliest opportunity for military applications, including both small- and large-scale applications.

30814 **(AD-A—189797/4/XAB) Stub penetration in chemical munition shipment. Final report.** Westine, P.S. (H and R Technical Associates, Inc., Oak Ridge, TN (USA)). May 1985. 30p. NTIS, PC A03/MF A01.

The M55 warhead carries a chemical agent that must be protected from accidental puncture in a shipment or handling accident. This report presents results from computer runs calculating the threshold impact velocity if a pallet of munitions or protective package containing several pallets were to be dropped onto rigid stubs of different radii. Calculations were made for three separate cases. Case 1 involved stub penetration of a fiberglass shipping container and then the aluminum walls of the round. Case 2 added an extra layer of protection so that wooden two by fours had to be penetrated before the shipping container and munition a CAMPACT shipping container loaded on a flat-bed railroad car or highway vehicle. The computer code used to make all computation is a dynamic plasticity, multi-penetration stage, one just developed by SRI for the U. S. Army Tank Automotive Command. Some comparisons are presented in which this code predicts experimentally observed penetrations to demonstrate the validity of its use in this study.

30815 **(AEEW-M—2091) Decommissioning a small glove box.** Bond, R.D.; McSherry, K. (UKAEA Atomic Energy Establishment, Winfrith; Department of the Environment, London (UK)). Nov 1985. 9p. (DOE-RW—84.204). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752725/JAW.

An account is given of dismantling a fuel fabrication glove box using simple tooling. The fissile content of the box was first measured by several non-destructive techniques. After cleaning, the box was dismantled using hand tools and finally packed for disposal. A record of operator radiation doses, the time taken for each stage of the operation and packing information is given.

30816 **(AERE-M—3637) Aerosol concentration profiles and related measurements in ventilation systems.** Parker, R.C.; Stevens, D.C. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Oct 1987. 14p. H.M. Stationery Office, London, price Pound 4.00.

In order to comply with Atomic Energy Act 1954, it is necessary to sample the exhaust gases from nuclear installations for any radioactive effluent. It is therefore necessary to test the efficiency of these measurement systems. This memorandum describes the methods used at Harwell Laboratory to evaluate the samplers. A method is described which basically consists of the injection of a submicron tracer aerosol into the duct downstream of the filtration system and then the measuring of the aerosol concentration profile at the fixed sampling point. The efficiency of a stack gas sampling system can be evaluated from the concentration profile. The methods used to calibrate the instruments involved are also described.

30817 **(BDX—613-3898) An automated precision skiving mill:Topical report.** Stone, W.J. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Mar 1988. Contract AC04-76DP00613. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007315/JAW.

Flexible flat cables and circuits are manufactured by laminating dielectric films over the etched foil circuitry for physical protection and electrical insulation. In subsequent manufacturing operations, the embedded circuit interconnection points must be exposed and drilled for wire insertion and soldering. Skiving (insulation removal by scraping via an end-mill-like tool and drill press) is the preferred technique for removing insulation because it minimizes the number of fabrication operations. A rudimentary dead-load skiving mill and controller was designed and built to investigate skiving as a possible automated cable manufacturing process. This basic experimental machine was automated and adapted for skiving a production flexible cable. 13 figs.

30818 **(BDX—613-3909) Technical feasibility study of applying auto-control methods to plating process solutions: Topical report.** Barben, C.L. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Mar 1988. Contract AC04-76DP00613. 71p.

This study was undertaken to quantify the feasibility of applying auto-controllers to metal finishing tanks in one Allied-Signal Inc., Kansas City Division plating department. Traditionally, analysis and correction have been performed manually; however, because of higher material and operating costs and the increased number of processing tanks, an automated approach is now sought to reduce cost and labor burdens. Literature and market searches were performed to discover the latest concepts, activities, and available equipment in the field of chemical auto-controllers. A ranking methodology was developed and the processing solutions were ranked for auo-control feasibility. 5 refs., 7 tabs.

30819 **(BDX—613-3915) Electron beam welding of 6061-T6 covers to A356-T6 machined cast housings: Final report.** Miller, G.P. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Mar 1988. Contract AC04-76DP00613. 52p.

An electron beam welding process was developed to replace the manual gas tungsten arc welding process for welding 6061-T6 aluminum covers to the A356-T6 cast aluminum machined housing for a Filter Pack Assembly. Design change recommendations must be incorporated prior to implementation of the electron beam welding process. 3 refs., 9 figs., 5 tabs.

30820 **(BDX—613-3920) Circular tapered tape fabrication: Final report.** Stockdale, D.A. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Apr 1988. Contract AC04-76DP00613. 24p.

A new approach to producing tapered tapes has been developed involving generating a tapered tape in a circular configuration on a lathe rather than a mill. This approach is more cost-effective and the redesigned slot configuration induced less stress on the tapes during installation and removal.

30821 **(BNL—40992) FASTRUN pipeline prototype testing and verification software diagnostic programs.** Sweely, H.D. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 80p.

A software engineering goals for the "FASTRUN" project are twofold: the MicroVax II interface to the Fastrun attached processor, and verification diagnostic for acceptance and maintenance. Hardware integrity is obviously an important aspect of successful software execution. This paper documents the procedures

for executing verification diagnostics and source code used for these procedures.

30822 (BNL—41040) X-ray and optical analysis of surface properties of metal optics. Matsui, Y.; Ulmer, M.P.; Takacs, P.Z. (Northwestern Univ., Evanston, IL (USA). Dept. of Physics and Astronomy; Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-8708110—34).

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

We replicated by electroforming grazing incidence Wolter type I mirrors for 7-keV X-rays from two superpolished mandrels. Optical profiler measurements on both the masters and mirrors were made to understand the ability of the replication technique and to understand the X-ray reflecting performance of the mirrors. To directly determine the performance of the mirrors, single mirrors and a nested pair were tested with a near-parallel beam of 1.5 and 6.4 keV X-rays that filled the opening aperture of the optics. We found that the FWHM's of their point spread functions were less than {approximately} 20 arcsec and total effective areas were {approx←gt} 70{percent} of the theoretical values. We also compared X-ray results with optical profiler measurements by use of a computer code. We found that the X-ray measurements are consistent with predictions made from the optical measurements and the computer code. Based on this, the surface microroughness requirements necessary to achieve a half power diameter less than 1.5 arcmin for 7 keV X-rays are a high-frequency roughness <14 A and a mid-frequency roughness <70 A for our 25 arcmin grazing incidence optics. 13 refs., 6 figs., 4 tabs.

30823 (CEA-CONF—9169) Aiding by ergonomic study of manipulators's working post. Frossard, H.; Hennebaut, J.M.; Streiff, G. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France)). May 1987. 5p. (In French). (CONF-8705280—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753042/JAW.

From DESUP seminar on ergonomics and human ecology; Paris, France (15 May 1987).

Short communication.

30824 (CEA-DAS—398) Previsional evaluation of risks associated with ground transportation of uranium hexafluoride. Pages, P.; Tomachevsky, E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 9p. (In French). (CONF-8610337—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753049/JAW.

From SFRP meeting on mastering of a transport system for dangerous materials; Paris, France (7 Oct 1986).

This communication is a concrete example of application of the evaluation method for risks associated with road transportation of uranium hexafluoride by 48Y shipping container. The statistical bases for UF6 transportation are given by analysis of the list of accidents for dangerous road transportation. This study examines all parameters (cost-safety-meteorology-radiation doses) to take in account in the safety analysis of the UF6 transportation between Pierrelatte and Le Havre.

30825 (CONF-880117—3) A concurrent on-board vision system for a mobile robot. Jones, J.P. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p.

From 3. conference on hypercube concurrent computers and applications; Pasadena, CA, USA (19 Jan 1988).

Robot vision algorithms have been implemented on an 8-node NCUBE-AT hypercube system onboard a mobile robot (HERMIES) developed at Oak Ridge National Laboratory. Images are digitized using a faremgrabber mounted in a VME rack. Image processing and analysis are performed on the hypercube system. The vision system is integrated with robot navigation and control software, enabling the robot to find the front of a mockup control panel, move up to the panel, and read an analog meter. Among the concurrent algorithms used for image analysis are a new component labelign algorithm and a Hough transform algorithm with load balancing. 14 refs., 3 figs., 2 tabs.

30826 (CONF-880545—1) Operational experience and design recommendations for teleoperated flight hardware. Burgess, T.W.; Kuban, D.P.; Hankins, W.W.; Mixon, R.W. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 21p.

From 22. aerospace mechanisms symposium; Hampton, VA, USA (4 May 1988).

Teleoepration (remote manipulation) will someday supplement/minimize astronaut extravehicular activity in space to perform such tasks as satellite servicing and repari, and space station construction and servicing. This technology is being investigated by NASA with teleoperation of two space-related tasks having been demonstrated at the Oak Ridge Nattional Laboratory (ORNL). This paper discusses the releoperator experiments conducted at ORNL the for Langley Research Center and summarizes the results of these experiments and the related equipment design recommendations. A general discussion of equipment design for teleoperation is also included.

30827 (CONF-880685—1) Real-time implementation of a kinematic optimization scheme for seven-degree-of-freedom redundant robots with spherical wrists. Dubey, R.V.; Euler, J.A.; Babcock, S.M.; Glassell, R.L. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 4p.

From American control conference; Atlanta, GA, USA (15 Jun 1988).

A computationally efficient, kinematic optimization scheme is presented for seven-degree-of-freedom robots with spherical wrists. This scheme uses the gradient projection method, and it does not require the generalized inverse of the Jacobian. An efficient formulation for determining joint velocities is obtained. Thus, this control scheme is well-suited for real-time implementation, which is essential if the end-effector trajectory is continuously modified based on sensory feedback. A comparison of the computational complexity with previously available schemes is presented. Implementation of this scheme on a Motorola 68020 VMEbus-based controller of the seven-degree-of-freedom manipluator at the ORNL Center for Engineering Systems Advanced Research (CESAR) is described. 8 refs., 5 figs., 1 tab.

30828 (DOE/CE/15263—T1) Ultrasonic reactor for the recovery of bitumen from tar sand: Final report. Bunger, J.W.; Miller, J.D.; Johnson, S.A. (Utah Univ., Salt Lake City (USA)). 28 Jul 1987. Contract FG01-86CE15263. 34p.

A bench scale ultrasonic reactor was designed for testing to determine its feasiblity for enhancing the dissolution and extraction of bitumen from Utah tar sands using both solvent and water as a liquid medium for dissolution and extraction and to compare the results. The ultrasonic reactor did not significantly enhance dissolution of bitumen into the sovlent. Ultrasonic energy did appear to enhance intraparticle diffusion in consolidated tar sand. The rate of disengagement of the bitumen from the sand in hot water extraction was slightly enhanced and a continuous flow unit may show promise for the recovery of bitumen from tar sands. Assuming that high recovery efficiency can be obtained, the energy requirements for the ultrasonic reactor did not appear to be prohibitive. 5 figs., 3 tabs.

30829 (DOE/CE/15263—T2) Apparatus for enhancing chemical reactions: Project summary, Phase 1: Final report. Sawyer, H.T. (Sawyer Applied Research, Pacific Palisades, CA (USA)). 14 Aug 1987. Contract FG01-86CE15263. 13p.

An apparatus and method for enhancing chemical reactions and separations in a constantly flowing stream of liquid character and fortified with agents such as solvent, water or other chemicals has been designed. It makes use of an inner resonant tube concentrically mounted within an outer resonant tube with walls of the tubes spaced from each other forming an annualr passageway for the flow of liquid material from open end of the passageway to the other. One or more sets of radially spaced ultrasonic magnetostrictive transducers are located on the outside wall of the resonant tube to create an ultrasonic cavitation condition in the liquid material as it flows through the annular passageway. Said reactor structure is supported on isolation mounts ot isolate the ultrasonic energy thus generated to the resonant structure. A power supply provides ultra-

sonic energy to the transducers, which in turn convert mechanical energy to acoustic energy that produces cavitation energy within the flowing medium. The feasiblity of using the reactor for the extraction of bitumen from Utah tar sand is discussed. 1 fig.

30830 **(EGG-M—30887) TMI-2 [Three-Mile Island-Unit 2] rail cask and railcar maintenance.** Tyacke, M.J.; Ayers, A.L., Jr.; Ball, L.J.; Anselmo, A.A. (EG and G Idaho, Inc., Idaho Falls (USA); EG and G, Inc., Middletown, PA (USA)). Feb 1988. Contract AC07-76ID01570. 13p. (CONF-880201—33).

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

This paper describes the NuPac 125-B cask system (i.e., cask and railcar), and the maintenance and inspection requirements for that system. The paper discusses the operations being done to satisfy those requirements and how, in some cases, it has been efficient for the operations to be more rigorous than the requirements. Finally, this paper discusses the experiences gained from those operations and how specific hardware and procedural enhancements have resulted in a reliable and continuous shipping campaign. 2 refs., 2 figs.

30831 **(FNAL-TM—1509-A) Ramping of solid iron analysis magnets in experimental areas: BM109 preliminary results: Addendum 1.** Visser, A.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 22 Feb 1988. Contract AC02-76CH03000. 15p.

This addendum lists all D.C. type loads in the experimental areas and concludes that a saving in the order of $1,000,000 per year is feasible by ramping a large portion of these D.C. operated loads. These savings are based on using the new future main ring pulse with a flattop of 30 seconds and a pulse period of 63 seconds at 800 GeV. This mode of operation was successfully tested in all experimental areas on 2/15/88. It is estimated that the total D.C. magnet load in all experimental areas is about 12.7 MW of which 7.7 MW can be ramped. A conservative ramping program, with a risetime of about 13 seconds, which reaches flattop value 7 seconds ahead of the main ring flattop, appears to be the most practical, but some loads may need overshoot programming. Ramping the presently D.C. operated power supplies requires the installation and procurement of about 40 ramp cards ({number<–sign}150) at a total estimated cost of $24,000. This is a very modest expense compared to the potential savings.

30832 **(FNAL-TM—1511) Investigation of leaks in fiberglass-reinforced pressure vessels by direct observation of hollow fibers in glass cloth.** McAdams, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 7p. NTIS, PC A; Q 02/MF A01;1; GPO Dep. Order Number DE88006936/JAW.

A simple method of visual observation of hollow fibers within fiberglass cloth has been developed. This visualization can aid in determining the contribution these fibers make toward leaks observed in fiberglass-reinforced epoxy resin pressure or vacuum vessels. Photographs and frequency data of these hollow fibers are provided. 3 figs.

30833 **(JAB—10343-3) Wind response of a tall building with full-scale observations.** Mills, R.S. (URS/John A. Blume and Associates, Engineers, San Francisco, CA (USA)). Feb 1988. Contract AC08-84NV10343. 77p. NTIS, PC A; 05/MF A01; GPO Dep. Order Number DE88007609/JAW.

Full-scale experimental studies provide a resource for definition of wind-induced structural response. Data obtained from a 16-story building provide information pertaining to both dynamic and quasistatic response. Potential building damage is related to displacement response. For the study building, quasistatic displacement was the dominant alongwind component, ranging from 80% to 95% of the peak displacement. Building acceleration consists of only a dynamic component and is applicable to human perceptibility analyses. An analytical methodology for predicting alongwind structural response provides reasonable comparisons to the dynamic experimental data. However, the experimental observations suggest that quasistatic response is overestimated by the numerical procedure. The experimental data also illustrate that torsion is an important element in wind-induced response and that it is produced by both aerodynamic and structural phenomena. Methodologies of this type, if combined with climatological data for a particular region, allow definition of recurrence figures. These figures provide projections of structural response for storms of varying probability. When compared with damage and perceptibility thresholds and combined with engineering judgment, this information permits knowledgeable assessment of building response. 34 refs., 19 figs., 5 tabs.

30834 **(LA-UR—88-709) The SRS [Segmented Rail Surface] railgun: A new approach to restrike control.** Parker J.V. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880478—7).

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

A Segmented Rail Surface (SRS) structure is described that eliminates restrike arcs by progressively disconnecting segments of the rail surface after the plasma armature has passed. This technique has been demonstrated using the Los Alamos MIDI-2 railgun. Restrike was eliminated in a plasma armature acceleration experiment using metal-foil fuses as opening switches. A plasma velocity increase from 11 to 16 km/s was demonstrated using the SRS technique to eliminate the viscous drag losses associated with the restrike plasma. This technique appears to be a practical option for a laboratory launcher at present and for future multi-shot launchers if appropriate switches can be developed. 5 refs., 8 figs.

30835 **(LA-UR—88-798) Use of fiber optic equipment for security.** Schalm, R.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880584—1).

From Carnahan conference; Lexington, KY, USA (1 May 1988).

This paper discusses the many applications of fiber optics equipment. (LSP)

30836 **(MLM—3482) High-pressure equipment: Hazards, operation, and safety, with emphasis on the haskel air intensifier pressure system.** Rogers, B.D.; Fisher, J.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 24 Mar 1988. Contract AC04-76DP00053. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007343/JAW.

The words "high pressure" can hold various meanings, and today, high-pressure technology is used in a wide variety of industries. Because energy is stored, pressure systems can be hazardous. Under certain circumstances, this energy can suddenly and unexpectedly be released, causing injury to personnel and/or damage to a facility. Therefore, when planning, designing, and determining operational procedures for pressure system use, the identification of hazards must be given the highest priority. Although the pressure vessel represents the single largest source of potential energy within a process system and its failure could be extremely catastropic, malfunctions in system components such as piping, valves, compressors, and pumps could also lead to equally catastrophic failures. Therefore, operator training must be thorough;it must not be cut short. Operators must develop an attitude and an awareness that is based on respect of the pressure system, and they must be aware that equipment subject to pressure must be routinely inspected to prevent unsafe operating conditions. 7 figs.

30837 **(MLM—3483) Semiautomated equipment for advanced timer fabrication.** Rogers, B.D.; Fisher, J.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 24 Mar 1988. Contract AC04-76DP00053. 15p.

Automated helical toroid winding equipment was developed and fabricated to control the quality and improve the precision of advanced timers incorporating helically wound and toroidally shaped mild detonating fuse (MDF) timing trains. This equipment consists of an automatic winding machine, a penumatic forming tool, and a shaping tool. The winder wraps the MDF into a helix, the forming tool forms the 90{degree} bend at the end of the helix that leads into the slapper assembly, and the shaping tool gives the MDG helix its toroidal configuration. Use of this equipment has reduced much of the human error associated with manual processes,

has allowed for higher yields, and has led to significant improvements in the areas of production rate and product consistency. 15 figs.

30838 **(N—88-18933) Computer-aided design analysis of 57-mm, angular-contact, cryogenic turbopump bearings.** Armstrong, E.S.; Coe, H.H. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Mar 1988. 15p. (NASA-TP—2816; E—3890; NAS—1.60:2816). NTIS, PC A03/MF A01.

The Space Shuttle main engine high-pressure oxygen turbopumps have not experienced the sevice life required of them. This insufficiency has been due in part to the shortened life of the bearings. To improve the life of the existing turbopump bearings, an effort is under way to investigate bearing modifications that could be retrofitted into the present bearing cavity. Several bearing parameters were optimized using the computer program SHABERTH, which performs a thermomechanical simulation of a load support system. The computer analysis showed that improved bearing performance is feasible if low friction coefficients can be attained. Bearing geometries were optimized considering heat generation, equilibrium temperatures, and relative life. Thermal gradients through the bearings were found to be lower with liquid lubrication than with solid film lubrication, and a liquid oxygen coolant flowrate of approximately 4.0 kg/s was found to be optimal. This paper describes the analytical modeling used to determine these feasible modifications to improve bearing performance.

30839 **(ORNL/Sub—87-06604/1) A cask fleet operations study.** (Transnuclear, Inc., Hawthorne, NY (HSA)). Mar 1988. Contract AC05-84OR21400. 294p.

This document describes the cask fleet currently available to transport spent nuclear fuels. The report describes the proposed operational procedures for these casks and the vehicles intended to transport them. Included are techniques for loading the cask, lifting it onto the transport vehicle, preparing the invoices, and unloading the cask at the destination. The document concludes with a discussion on the maintenance and repair of the casks. (tem) 29 figs.

30840 **(ORNL/TM—10763) Treatment of systematic errors in the processing of wide angle sonar sensor data for robotic navigation.** Beckerman, M.; Oblow, E.M. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 30p. (CESAR—88/07).

A methodology has been developed for the treatment of systematic errors which arise in the processing of sparse sensor data. We present a detailed application of this methodology to the construction from wide-angle sonar sensor data of navigation maps for use in autonomous robotic navigation. In the methodology we introduce a four-valued labelling scheme and a simple logic for label combination. The four labels, conflict, occupied, empty and unknown, are used to mark the cells of the navigation maps; the logic allows for the rapid updating of these maps as new information is acquired. The systematic errors are treated by relabelling conflicting pixel assignments. Most of the new labels are obtained from analyses of the characteristic patterns of conflict which arise during the information processing. The remaining labels are determined by imposing an elementary consistent-labelling condition. 26 refs., 9 figs.

30841 **(PB—88-862941/XAB) Cryogenic refrigeration. March 1982-April 1988 (Citations from the NTIS data base). Report for March 1982-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 126p. NTIS PC N01/MF N01.

Supersedes PB—87-859161.

This bibliography contains citations concerning the technological development and utilization of cryogenic-refrigeration methods and equipment. Performance evaluations of specific systems, equipment descriptions, and applications, including the cooling of instrumentation, superconductors, reactor devices, satellites, and other space-borne vehicles are considered. (This updated bibliography contains 251 citations, 34 of which are new entries to the previous edition.)

30842 **(PNL-SA—15653) Feasibility of performing criticality experiments with spent LWR fuel.** Bierman, S.R. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 17p. (CONF-880251—1).

From U.S. Department of Energy spent fuel burnup credit workshop; Washington, DC, USA (23 Feb 1988).

Criticality experiments can be performed with irradiated LWR fuel under very well defined and controlled conditions to provide data sutiable for verifying calculational models. Two facilities currently exist in which such experiments could be performed. Furthermore, the experiments can be performed in a timely manner and for a relatively reasonable cost. It is expected the cost will be greater than those normally incurred for similar experiments with unirradiated fuel because of the handling problems created by the high radiation fields. Although the cost will of course depend on the scoper of the experimental programs, current estimates indicate the costs will be less or comparable to a similar level of effort in other activities with irradiated fuel (e.g., Dry Rod Consolation Project). 2 figs.

30843 **(SAND—84-0606) Nondestructive evaluation of foam sidewalls in Super Tiger.** Uncapher, W.L.; Apple, M.L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 46p. (TTC—0778).

A nondestructive evaluation technique has been developed for determining the locations of anomalies in the foam sidewalls of overpack-type packagings used for the shipment of radioactive materials. This technique involves heating the interior walls of the packaging, then scanning its exterior walls with an infrared-sensitive imaging system to detect anomalies that compromise the insulating capacity of the foam. Infrared imaging tests were conducted on operational packagings, as well as on specially fabricated test panels. This report describes the development, validation, and use of the nondestructive evaluation technique and presents test results. 4 refs., 25 figs.

30844 **(SAND—87-1896) Thermal analysis of the 10-gallon and the 55-gallon DOT-6M containers with thermal boundary conditions corresponding to 10CFR71 normal transport and accident conditions.** Sanchez, L.C.; Longenbaugh, R.S.; Moss, M.; Haseman, G.M.; Fowler, W.E.; Roth, E.P. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 64p. (TTC—0748).

This report describes the heat transfer analysis of the 10-gallon and 55-gallon 6M containers. The analysis was performed with boundary conditions corresponding to a normal transport condition and a hypothetical accident condition. Computational results indicated that the insulation material in the 6M containers will adequately protect the payload region of the 6M containers. 26 refs., 26 figs., 8 tabs.

30845 **(SAND—87-2314C) Use of a two-stage light-gas gun as an injector for electromagnetic railguns.** Shahinpoor, M.; Asay, J.R.; Konrad, C.H.; Hall, C.A. (New Mexico Univ., Albuquerque (USA). Dept. of Mechanical Engineering; Sandia National Labs., Albuquerque, NM (USA)). Apr 1988. Contract AC04-76DP00789. 6p. (CONF-880478—5).

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

Ablation of wall materials is known to be a major factor limiting the performance of railguns. To minimize this effect, it is desirable to inject projectiles into railgun at velocities greater than the ablation threshold velocity (6 to 8 km/s for copper rails). Because two-stage light-gas guns are capable of achieving such velocities, a program was initiated to design, build and evaluate the performance of a two-stage light gas gun, utilizing hydrogen gas, for use as an injector to an electromagnetic railgun. This effort is part of a project to develop a hypervelocity electromagnetic launcher (HELEOS) for use in equation-of-state studies. In this paper, the specific design features that enhance compatibility of the injector with the railgun, including a slip-joint between the injector launch tube and the coupling section to the railgun are described. The operational capabilities for using all major projectile velocity measuring techniques, such as in-bore pressure gauges, laser and CW x-ray interrupt techniques, flash x-ray and continuous in-bore velocity

measurements using VISAR interferometry are also discussed. Finally an internal ballistics code for optimizing gun performance has been utilized to interpret performance data of the gun.

30846 **(SAND—87-2393C) Laboratory simulation of axial and angular projectile accelerations in a rifled gun barrel.** Davie, N.T.; Bell, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 4p. (CONF-880566—1).

From IES annual technical meeting; Valley Forge, VA, USA (2 May 1988).

A new test technique has been proposed for simulating both the linear and angular acceleration shocks produced during artillery shots. This technique uses a two mass fixture with a screw connection between the two masses. An axial force applied to the first mass is transmitted to the second mass through the screw connection which produces an axial and angular acceleration on the second mass. The ratio of axial to angular acceleration can be controlled by variation in mass properties of the two mass fixture. A simple fixture was constructed to verify the test concept at low shock levels. Test results using this fixture are shown. 1 ref., 6 figs.

30847 **(SAND—87-2567) Strategic placement of accelerometers to measure forces by the sum of weighted accelerators.** Priddy, T.G.; Gregory, D.L.; Coleman, R.G. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007495/JAW.

A force identification method using a sum of weighted accelerations (SWA) has recently been demonstrated. Accuracy of the SWA method depends on the number and placement of the accelerometers and the selection of the best set of weighting factors. Procedures have been proposed for determining the number of accelerometers required for a given frequency bandwidth and an experimental-analytical method has been derived to calculate the optimum set of weighting coefficients. A procedural method is described and demonstrated in this paper for determining the placement of gages using results from a free-body modal characterization. Our proposed procedure is to place accelerometers at the nodes of the highest free-body vibrational mode in the frequency bandwidth of interest. All modes below this mode are well represented in the acceleration measurements. The weighting factors can be determined by the previously reported methods or according to a theoretical method introduced in this paper. The present method satisfies the objective of "zeroing-out" the contribution of free-body vibration modes in the SWA method of force identification. We illustrate the theory through the analysis of a simple beam, and we then demonstrate the procedure with the laboratory testing of a softly suspended aluminum beam.

30848 **(SAND—87-2728C) A new approach to machine-based perception of monocular images.** Osbourn, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 31p. (CONF-880637—1).

From IEEE Computer Society conference on computer vision and pattern recognition; Ann Arbor, MI, USA (5 Jun 1988).

A new approach to machine-based visual perception of monocular images is presented and demonstrated. The approach employs a recursive procedure to generate a series of "reconstructed" versions of the raw video image. The procedure is designed to imitate certain perceptual organization functions of the human visual system. Recognition of object categories is attempted at each step by comparing the newly generated regions to stored object categories. These generated regions may have relatively few edges or region pixels in common with any of the regions in the raw video image. Category retrieval is carried out using a software-based content-addressing scheme which provides access to complete object representations in memory using incomplete portions of the representation. The category representation scheme is sufficiently general to allow a variety of poorly correlated images of specific category examples to be represented and recognized by a single general category representation. These properties are illustrated using a group of distorted, defective and idealized images of ascii A's and handguns. 7 refs., 10 figs.

30849 **(SAND—87-3081C) High bandwidth optoelectronic signal link for use in an EMP [electromagnetic pulse] plus radiation environment.** Garcia, P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880579—4).

From 10. annual ideas in science and electronics exposition; Albuquerque, NM, USA (10 May 1988).

Electronic systems which must operate in an electromagnetic pulse (EMP) environment are often enclosed in a conducting box, or Faraday enclosure. The conducting walls must have apertures to allow communications with systems outside the enclosure. EMP leakage is minimized when the aperture diameter is small and has finite thickness. Optical signals, because of their short wavelength, can efficiently traverse apertures that are highly attenuating to EMP signals. A communication link consisting of a GaAlAs laser diode source and a photodiode detector is well-suited to this application. 7 figs.

30850 **(SAND—88-0540C) Simple 2-D navigation for wheeled vehicles.** Klarer, P.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 20p. (CONF-880689—1).

From 15. AUVS annual technical symposium; San Diego, CA, USA (6 Jun 1988).

This paper describes a simple algorithm to perform navigation in a two-dimensional world model. The algorithm utilizes a simple geometric approach which is first applied to a bicycle. The equations are then expeanded to apply to 3- and 4-wheeled vehicles with "conventional" steering mechanism (such as the Ackerman steering geometry in the 4-wheeled case). Calculations for omnidirectional robots which utilize differential odometry and differential drive are described as well. Practical considerations and sources of error are discussed, as are possible extensions of this method to a three-dimensional world model. 5 refs., 8 figs.

30851 **(SAND—88-0669C) Analysis of binarized Hartley phase-only filter performance with respect to stochastic noise.** Dickey, F.M.; Mason, J.J.; Stalker, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880462—4).

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

Binary phase-only filters (BPOF) are a viable canidate for the replacement of matched filters in real-time image processing and pattern recognition applications. The original BPOFs were binarized versions of the real or imaginary parts of the Fourier transform. Recently, a filter has been proposed which is the binarized Hartley transform. In this paper, the noise performance of the binarized Hartley phase-only filter is analyzed and compared to other BPOFs as well as the phase-only and matched filter. It is well known that the matched filter optimizes signal-to-noise ratio. Further, it can be shown that the matched filter phase is the optimum phase-only filter. A bound on the BPOF signal-to- noise ration relative to that of the phase-only filter is derived. Finally, the analysis is applied to the generalized form of the binarized Hartley transform. 12 refs., 5 figs.

30852 **(SAND—88-1137C) Digital image processing for some national defense problems.** Mastin, G.A.; Ghiglia, D.C. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880577—3).

From Military computing conference; Anaheim, CA, USA (3 May 1988).

Image processing is playing an increasingly significant role in a wide variety of defense related activities. The traditional emphasis in surveillance and remote sensing is being complemented by new applications in research diagnostics, model verification, quality control, and design simulations. This breadth of applications requires a broad set of sophisticated enhancement, analysis, and restoration algorithms. When coupled with recent advances in computing technology, these algorithms, as well as some formerly thought to be too complex, can be applied in a timely fashion. This paper highlights some of the broad applications of image processing at Sandia National Laboratories. Unique algorithms, as well as modern computing architectures and technologies, are cited in these applications. 15 refs., 10 figs.

30853 (UCID—21236) 1986 LLNL enclosure fire tests data report. Foote, K.L. (Lawrence Livermore National Lab., CA (USA)). 5 Aug 1987. Contract W-7405-ENG-48. 42p.

We conducted 64 enclosure fire tests in the Lawrence Livermore National Laboratory (LLNL) fire test cell, and, exploring several parameters of forced ventilation enclosure fires, completed a wide variety of tests. These tests were conducted to improve the fire risk in the Department of Energy (DOE) facilities. The results showed that a variety of factors influence temperature profiles in forced ventilation fires. In this report, we detailed the instrumentation, test procedures, and some of the data collected and hope that this information will provide a basis for futher analysis of the data. 2 refs., 8 figs., 5 tabs.

30854 (UCRL—21034) Evaluation of vertical monopole antennas with elevated radials. Breakall, J.K.; Christman, A.M. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 193p.

The Numerical Electromagnetics Code (NEC) was used to model a 32-foot vertical radiator operating over a variety of ground systems at several frequencies throughout the HF band. Recent work performed at LLNL indicated that superior peroformance could be achieved from a vertical monopole by elevating the radiator a short distance above the surface of the earth, when used in conjunction with a ground system composed of 4 elevated horizontal radials. Field tests were performed on several elevated-radial configurations as well as conventional ground-mounted vertical antennas using up to 120 radials in an attempt to confirm this hyporthesis. The results of field-strength and input-impedance measurements are contained herein.

30855 (UCRL—97384) STARFIRE: Hypervelocity railgun development for high-pressure research. Hawke, R.S.; Susoeff, A.R.; Asay, J.R.; Balk, J.K.; Hall, C.A.; Konrad, C.H.; McDonald, M.J.; Schuler, K.W.; Wellman, G.W.; Hickman, R.J.; Shahinpoor, M.; Sauve, J.L. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA); EG and G Energy Measurements, Inc., Albuquerque, NM (USA)). 1 Mar 1988. Contract W-7405-ENG-48. 5p. (CONF-880478—10).

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

STARFIRE, a program based at Sandia National Laboratories, has as its goal the development of a hypervelocity railgun for use as a high-pressure research tool. The program has included efforts to identify and solve the problems that have inhibited reliable attainment of velocities greater than the 8 to 9 km/s attainable with two-stage light-gas guns (2SLGG). Issues studied include: plasma arc formation and stabilization, restrike inhibition, viscous drag, ratio of preload to operationg stresses, barrel joint design, and barrel precision requirements. The system uses a 2SLGG as an injector to minimize barrel ablation and armature contamination. Hydrogen is used as the injection gas and will also serve to reduce the probability of forming secondary arcs. A VISAR optical Doppler system is used to continuously and precisely measure the projectile velocity from a standing start in the 2SLGG barrel, through several joints, the HELEOS (Hypervelocity Experimental Launcher for Equation of State) railgun barrel, and post-launch. The STARFIRE program is focused on the combined use of precision diagnostics and new experimental techniques. Results of tests are presented. 20 refs., 2 figs.

30856 (UCRL—98228) Fabrication issues and technology development for HELEOS [Hypervelocity Electromagnetic Launcher for Equation of State]. Susoeff, A.R.; Hawke, R.S.; Balk, J.K.; Hall, C.A.; McDonald, M.J. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48;AC04-76DP00789. 6p. (CONF-880478—6; SAND—88-0843C).

From 4. symposium on electromagnetic launch technology; Austin, TX, USA (12 Apr 1988).

Starfire is a joint railgun project of Lawrence Livermore National Laboratory and Sandia National Laboratory and Sandia National Laboratory-Albuquerque. The goal of Starfire is to develop a Hypervelocity Electromagnetic Launcher for Equation of State (HELEOS) experiments. A two-stage light-gas gun is used as pre-injector. Each round-bore HELEOS railgun module is 12.7 mm in diameter and 2.4 m long. The muzzle end of the railgun is connected to a vacuum tank. Common materials and fabrication technology are used in the manufacture of all components,a nd modular design allows for extending the length of the railgun as progress dictates. The launcher uses a "vee block" geometry, which is designed to: provide compressive preload; operate with a 300-MPa (3-kbar) internal bore pressure; and easily accommodate interchangeable materials in the bore support structure and rail. We have performed full-scale material testing of the railgun and have developed a precision round-bore fabrication process. Air-gage inspection is used to determine bore diameter and straightness. We have also developed a surface mapping system to document the surface topography of the bore before and after an experiment. This paper presents fabrication details, results of tests conducted, and areas for potential improvement. 12 refs., 6 figs., 1 tab.

30857 Glow discharge techniques for conditioning high-vacuum systems. Dylla, H.F. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08543). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1276-1287(May 1988).

A review is given of glow discharge techniques which are useful for conditioning vacuum vessels for high-vacuum applications. Substantial development of glow discharge techniques has been done for the purpose of in situ conditioning of the large ultra-high vacuum systems for particle accelerators and magnetic fusion devices. In these applications the glow discharge treatments remove impurities from vessel surfaces in order to minimize particle-induced desorption coefficients. Cleaning mechanisms involve a mixture of sputtering and ion(or neutral)-induced desorption effects depending on the gas mixture (Ar/O_2 vs H_2) and excitation method (dc, rf, and electron cyclotron resonance). The author will review the methodology of glow discharge conditioning, diagnostic measurements provided by residual gas and surface composition analysis, and applications to vessel conditioning and materials processing.

30858 Applications of surface analytical techniques to the characterization of catalytic reactions. Campbell, C.T. (Chemistry Department, Indiana University, Bloomington, Indiana 47405). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1108-1112(May 1988).

Instrumentation which combines ultrahigh vacuum surface analytical methods with an attached high-pressure microcatalytic reactor has received increasing use in the study of structure/function relationships in heterogeneous catalysis. In particular, the activities and selectivities of model catalysts which are very homogeneous and well characterized in terms of atomic-level surface structure and composition have been compared for a number of simple reactions of industrial interest. The results are helping to elucidate the nature of active sites on catalyst surfaces; the roles of poisons, promoters, and supports; and electronic factors in catalysis. This article briefly discusses some design considerations for instrumentation used in this approach, and extensively reviews its applications by many laboratories to study simple catalytic reactions.

30859 Room-temperature phosphorimetry to study petroleum product permeation through protective clothing materials. White, D.A.;Vo-Dinh, T. (Advanced Monitoring Development Group, Health & Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6101). *Applied Spectroscopy;* **42**: No. 2, 285-288(Feb 1988). Contract AC05-84OR21400.

In this study a simple analytical tool based on room-temperature phosphorimetry (RTP) is developed and used for evaluating the effectiveness of protective clothing materials against permeation of organic substances containing compounds such as the polycyclic aromatic compounds. A special permeation cell is designed, which allows direct RTP measurements of the permeated products after exposure, without requiring any sample extraction procedure. Re-

sults for a variety of petroleum product-protective material combinations illustrate the usefulness of the technique.

4203 Lasers

REFER ALSO TO CITATION(S) 30634, 30663, 30899, 30997, 31362, 31669, 31818

30860 **(AD-A—189163/9/XAB) Research studies on extreme-ultraviolet and soft-x-ray lasers. Annual technical report, 1 September 1986-31 August 1987.** Harris, S.E.; Young, J.F. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). 15 Oct 1987. 19p. NTIS, PC A03/MF A01.

Operation of a 109-nm Auger Laser in Xe III and high gain on the 131-nm line of Zn III is reported. Progress and improvements on the depletion-spectroscopy technique are also reported.

30861 **(AD-A—189180/3/XAB) Saturation of the Xe III 109-nm laser using traveling-wave laser-produced-plasma excitation.** Sher, M.H.; Macklin, J.J.; Young, J.F.; Harris, S.E. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Nov 1987. 3p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 11, 891-893(Nov 1987).

Construction and operation of a 109-nm, photoionization-pumped, single-pass laser in Xe III are described. The laser is pumped by soft x rays emitted from a laser-produced plasma in a traveling-wave geometry. Using a 3.5-J, 300-psec, 1064-nm laser pump pulse, a small-signal gain coefficient of 4.4/cm and a total small-signal gain of exp(40) were measured. The laser is fully saturated and produces an output energy of 20 micro J in a beam with 10-mrad divergence.

30862 **(AD-A—189514/3/XAB) Semiclassical theory of injected lasers with arbitrary stable and unstable resonators. Doctoral thesis.** Rinaldi, S.M. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 336p. (AFIT/DS/PH—76-3). NTIS, PC A15/MF A01.

A semiclassical analysis of injected lasers with stable and unstable resonators and arbitrary outcoupling fractions was performed. Homogeneously broadened lasers with Fabry-Perot and with positive branch, confocal unstable resonators were modeled. Both time-dependent and steady-state analyses of free-running and injected lasers were performed. Because of deficiencies in the standing-wave semiclassical and the simple saturable gain models, a new semiclassical theory of homogeneously broadened lasers were developed. The theory is predicted upon the following assumptions: the atoms are two-level, a single longitudinal mode exists in the cavity, the transverse mode structure can be adequately modeled by the geometric optics mode, and the laser electric fields can be described by a pair of counterpropagating planar, cylindrical, or spherical traveling waves with different amplitudes. A general semiclassical theory was first developed, and then specialized to the Fabry-Perot and positive branch, confocal unstable resonator cases. Both the Maxwell-Bloch and rate-equation approximation forms of the theory were derived. The general theory is sufficiently broad to allow the modeling of the geometric optics mode of any standing-wave resonator configuration. The theory was shown to reduce to the simple saturable gain and standing-wave semiclassical models in the appropriate limits. The analysis of the injected lasers was performed with the new semiclassical theory. Both time-dependent and steady-state analyses were performed.

30863 **(AD-A—189558/0/XAB) Resonator coupling of two-ring cavity, argon-ion lasers. Master's thesis.** Abraham, W.O. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 57p. (AFIT/GEO/ENP—87D-1). NTIS, PC A04/MF A01.

This thesis reports on a study of phasing two continuous-wave, resonator-coupled, argon-ion ring lasers. Rings with cavity lengths of about 3.4 meters were formed from Spectra Physics Model 164 and 165 lasers. These rings were coupled in several configurations, and portions of each ring output were combined to form a mixed beam, which was monitored for phase locking (frequency locking and coherence) with a Fabry-Perot scanning interferometer and a fast photodiode. Short-term phase locking was achieved (2.5 msce) when at least one ring was operated in multimode. Precise frequency tuning of rigs operating in single mode was not possible, therefore phase locking of two single mode rings' lasing thresholds did not affect phase locking, but increasing the coupling strength between the resonators increased the duration of phase-locking activity. Suppression of intracavity air turbulence increased the frequency range within which phase locking occurred.

30864 **(AD-A—189800/6/XAB) Coupled high-power waveguide laser research. Final report, 1 July 1986-30 June 1987.** Cantor, A.J.; Hart, R.A.; Kennedy, J.T.; Newman, L.A. (United Technologies Research Center, East Hartford, CT (USA)). 30 Sep 1987. 48p. (UTRC/R—87-927184). NTIS, PC A03/MF A01.

The experimental and theoretical progress made in the coupled high-power waveguide laser research program is reported. A problem was encountered with the hollow-bore ridge-waveguide laser-array approach in which multimode operation occurs when the array is increased to above three elements. Alternative waveguide geometries were explored with the objective of achieving both phase-locked operation and mode discrimination for an array size of 5 elements. Three new waveguide geometries were investigated. Of these new geometries, a modified hollow-bore ridge waveguide, utilizing a staggered ridge, was used successfully to obtain single-mode operation. This array, with a gain volume equivalent to six waveguide lasers, produced an output of 68 watts. The theoretical effort resulted in the development of a theoretical method for calculating the modes and frequencies of two coupled rectangular waveguides separated by an infinitely thin partition with a gap in it.

30865 **(BNL—40985) Progress toward a soft x-ray FEL.** Pellegrini, C. (Brookhaven National Lab., Upton, NY (USA)). Sep 1987. Contract AC02-76CH00016. 8p. (CONF-8709110—23). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007669/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The recent successes in operating Free Electron Lasers (FELs) from the far infrared to the visible and near UV, together with a better understanding of the physics and technology of these systems, is leading us to explore again the possibility of using FELs to produce coherent radiation in the XUV region, at wavelength shorter than 100 nm. In this paper we derive a set of scaling laws, which we will use to study XUV FELs, to obtain their possible performance, and, most important, to determine the characteristics of the electron beam needed to drive the FEL. To build a XUV FEL there are two main issues that we must face: to obtain mirrors with large enough reflectivity to build an optical cavity in this wavelength rants;to produce an electron beam with the energy, high density, and small momentum spread, required to produce large gain. 17 refs., 1 tabs.

30866 **(LA-UR—88-696) Application of pulse compression and shaping to the FEL photoelectric injector.** Nguyen, D.C.; Watkins, D.E.; Weber, M.E. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880110—25).

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

We discuss the application of self-phase modulation and grating pulse compression to the generation of temporally trapezoidal optical pulses for controlling the electron beam emitance and energy spread in an FEL photoelectric injector. Pulse compression i n a single-stage pulse compressor, with background reduction based on the nonlinear birefringence of the optical fiber, yields 3-ps, compressed pulses without background pedestals or sidelopes. Trapezoidal, flat-topped pulses with 20-ps FWHM and 4-ps risetime have been obtained through self-phase modulation and group-velocity dispersion of the 3-ps pulses in a second fiber. Pulse shaping through Fourier transform amplitude and phase masking in the frequency domain and the amplification of the trapezoidal pulses ar also discussed. 14 refs., 9 figs.

30867 **(PB—88-862438/XAB) Carbon dioxide lasers. April 1985-March 1987 (Citations from the Engineering Index data base). Report for April 1985-March 1987.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 147p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the design, testing, and evaluation of carbon dioxide lasers, for both continuous wave and pulsed operations. Included are references to modulation, cooling, modeling, excitation, and saturation studies. (This updated bibliography contains 354 citations, none of which are new entries to the previous edition.)

30868 **(PB—88-862446/XAB) Carbon dioxide lasers. April 1987-April 1988 (Citations from the Engineering Index data base). Report for April 1987-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 35p. NTIS PC N01/MF N01.

Supersedes PB—87-857207.

This bibliography contains citations concerning the design, testing, and evaluation of carbon dioxide lasers, for both continuous wave and pulsed operations. Included are references to modulation, cooling, modeling, excitation, and saturation studies. Some references cover trends in the use of carbon dioxide lasers in manufacturing industries. Specific applications, other than these trend forecasts, of carbon dioxide lasers are found in other published searches. (This updated bibliography contains 64 citations, all of which are new entries to the previous edition.)

30869 **(SAND—87-3084C) An elliptical spectrograph/gated microchannel plate detector for time-resolved spectral measurements in the x-ray region.** Hammel, B.A.; Ruggles, L.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880364—6). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007590/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Time-resolved measurements from an elliptical crystal spectrograph are used to diagnose x-ray laser experiments on a gas puff Z-pinch. The elliptical spectrograph (1.2 m working distance, eccentricity = 0.9586) observes the 1 keV region, covering a range of $\lambda/2d$ = 0.5 - 0.9. A thin filter (0.2 μm Al on 2 μm Kimfol) stretched across the spectrograph exit slit acts as a low energy x-ray cutoff and as a vacuum window, allowing the detector to be at high vacuum regardless of the pressure in the experimental chamber. The detector consists of a 7-frame microchannel plate intensifier system. A pulser is used to gate each of 7 striplines on the microchannel plate, providing nanosecond resolution. With this instrument we are able to measure the pump radiation from the imploding plasma (Ne or Ar) and converter layer (Al), and to study the lasant ionization state (Ne-like Ni or Cu). 10 refs., 7 figs.

30870 **(UCRL—95880-Rev.1) Fracture of solid state lasers.** Marion, J.E. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 13p. (CONF-8708110—33-Rev.1).

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

The understanding of fracture in solid state lasers is reviewed, with an emphasis on fracture of high average power thin slabs. Methods for characterizing strength in the context of materials selection and device implementation are discussed. Progress in slab strengthening is analyzed; aggressive optical fabrication research (to give low damage surfaces), coupled with the implementation of existing schemes for placing the slab surfaces in compression, are recommended to reduce the problem of slab fracture.

30871 **(UCRL—98103) Reducing sensitivity to errors in free electron laser amplifiers.** Shay, H.D.;Scharlemann, E.T. (Lawrence Livermore National Lab., CA (USA)). 14 Jan 1988. Contract W-7405-ENG-48. 20p. (CONF-8709110—22). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007017/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

random errors that affect the transport of electron beams through long wigglers can degrade the performance of free-electron laser amplifiers. We describe the origin and magnitude of the degradation, and test (with simulations) possible ways to improve amplifier performance in the presence of errors. 6 refs., 8 figs., 1 tab.

30872 **Excited state absorption of Sm^{2+} in SrF_2 and $SrCl_2$.** Payne, S.A.; Chase, L.L.; Krupke, W.F.; Boatner, L.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Chemical Physics;* **88**: No. 11, 6751-6756(1 Jun 1988). Contract W-7405-ENG-48.

The excited state absorption spectrum of Sm^{2+} diluted as an impurity in the single crystal hosts SrF_2 and $SrCl_2$ has been observed. The absorption peaks associated with the $^5D_0(4f^6)$ excited state were found to be displaced by approximately 3000 cm^{-1} from the absorption bands arising from the $^7F_0(4f^6)$ ground state when the $^5D_0$—$^7F_0$ energy was taken into account. The observed peak separation is ascribed to the 4f—5d exchange interaction. From the measured peak positions and band intensities, the exchange energy for the Sm^{2+} impurity in the two host crystals was determined to be about the same order of magnitude as that expected for the free ion. The implications of the properties of the excited state absorption bands for the performance of $CaF_2:Sm^{2+}$ and $SrF_2:Sm^{2+}$ lasers are considered.

30873 **2.0-J Ti:sapphire laser oscillator.** Muller C.H. III; Lowenthal, D.D.; Kangas, K.; Hamil, R.A.; Tisone, G.C. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, Washington 98004). *Optics Letters;* **13**: No. 5, 380-382(May 1988).

A 2-J Ti:sapphire laser oscillator has been constructed by using an end-pumped configuration. The pump laser delivered as much as 10 J of energy (40—50 J cm^{-2}) at 495 nm over a 4-μsec pulse length with no damage to the Ti:sapphire crystal. Ti:sapphire laser conversion efficiencies of 20% were obtained, and no parasitic oscillations were observed. A side-pumped Ti:sapphire oscillator delivered 0.7 J when pumped by 8 J of 495-nm radiation.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 29855, 29903, 29955, 29961, 30246

30874 **(AD-A—189639/8/XAB) Efficient parallel algorithm for the simulation of three-dimensional compressible transition in a 20 processor Flex/32 multicomputer. Final report.** Erlebacher, G.; Bokhari, S.H.; Hussaini, M.Y. (National Aeronautics and Space Administration, Hampton, VA (USA). Inst. for Computer Applications in Science and Engineering). Jul 1987. 20p. (ICASE—87-41). NTIS, PC A03/MF A01.

The compressible, three-dimensional, time-dependent Navier Stokes equations are solved on a 20 processor Flex/32 computer. The code is a parallel implementation of an existing code operational on the Cray 2 at NASA Ames, which performs direct simulations of the initial stages of the transition process of the transition process of wall-bounded flow at supersonic Mach numbers . Spectral collocation in all three spatial directions (Fourier along the plate and Chebyshev normal to it) insures high accuracy of the flow variables. By hiding most of the parallelism in low-level routines, the casual user is shielded from most of the non-standard coding constructs. Speedups of 13 out of a maximum of 16 are achieved on the largest computational grids.

30875 **(AD-A—189752/9/XAB) Zonal approach for the solution of coupled Euler and potential solutions of flows with complex geometries. Final report, 1 July 1986-1 June 1987.** Ecer, A. (Indiana Univ.-Purdue Univ., Indianapolis (USA). School of Engineering and Technology). 1 Feb 1988. 12p. NTIS, PC A03/MF A01.

A block-structured solution schemes developed for the solution of three-dimensional Euler equations was implemented on the Intel Hypercube computer. By using this scheme, a complex flow

problem is divided into a series of blocks. Each block is stored on an individual processor of the system and solved. The boundary conditions between the neighboring blocks are iteratively calculated. The communication of the boundary conditions between neighboring blocks occur on individual I/O channels.

30876 **(DOE/ER/13528—2) Subcooled sprays in a vapor environment: Progress report, May 15, 1987-March 1, 1988 Tests of the two-fluid model for two-phase flow:.** Wallis, G.B.; Richter, H.J. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). Mar 1988. Contract FG02-86ER13528. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007445/JAW.

Subcooled water sprays in a steam environment have been studied theoretically and experimentally. The sprays were produced from orifice plates in which many holes were drilled. Droplet temperatures within the spray and the overall spray shape were measured and compared with theory. Measurements of droplet and steam velocities are planned.

30877 **(IC—87/287) Similar flow between two disks in the presence of a magnetic field.** Hamza, E.A. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702689/JAW.

A similarity solution may be obtained for a flow between two parallel disks which, at time t^*, are spaced a distance $H(1-\alpha t^*)^{1}2$ apart and a magnetic field proportional to $B_0(1-\alpha t^*)^{-1}2$ is applied perpendicular to the disks. Approximate analytic solutions are given and a numerical solution to the resulting nonlinear ordinary differential equations is presented. The effects of the magnetic forces on the velocity profiles and on the normal forces which the fluid exerts on the disks are studied. It has been found that by increasing the magnetic force a considerable increase in the load can be achieved. (author). 9 refs, 4 figs.

30878 **(IC—87/302) On the thermal stability of a chemically reacting gas in a porous sphere.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702702/JAW.

The problem is centred around the determination of the stability boundary of a binary mixture of a chemically reacting gas inside a porous sphere in a radially symmetric gravitational field. Under small perturbation theory, the system of nonlinear partial differential equations is reduced to a homogeneous linear eigenvalue problem for the stability parameter. The solution of the eigenvalue problem is reduced to familiar infinite secular determinant by variational formalism. The effect of the reaction rate constant on the stability parameter is discussed quantitatively. The problem is paramount in geophysics. (author). 4 refs, 1 tab.

30879 **(IC—87/303) On the stability of a radiating fluid in a porous spherical shell.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702703/JAW.

The onset of thermal instability in a fluid filled porous spherical shell is investigated when the temperatures of the walls are large enough for thermal radiation to be significant. Assuming that the gravitational field is radially symmetric and the porous medium consists of fluid which is optically thin, non-grey and near equilibrium, the problem is reduced to the determination of the eigenvalues for a set of linear homogeneous equations with variable coefficients. The effect of porosity and radiation on the stability parameter is discussed quantitatively. (author). 6 refs, 1 tab.

30880 **(IC—87/304) Radiative heat transfer to steady flow of a chemically reacting fluid in a horizontal porous channel with variable wall temperature.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702704/JAW.

Fluid motion in a horizontal channel at very high temperatures is studied when the radiative heat flux is expressible in general differential form. On the assumption that the fluid is chemically reacting while the temperatures of the channel walls vary linearly with axial distance, the problem is reduced to a set of coupled nonlinear ordinary integro-differential equations when only linear terms in the axial distance are retained. An iterative sequence is established in which the eventual linear equations are discretized by employing finite differences for derivatives and trapazium rule for integrals. The effect of the chemical rate constant and the radiative parameters on the flow are discussed. (author). 5 refs, 2 figs.

30881 **(INIS-SU—24) Transport coefficients of binary simple gas mixtures at high pressures.** Pozhar, L.A.; Shchelkunov, V.N.; Akhmatskaya, E.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702811/JAW.

Preprint--31-86.

On the base of the empirical correlations the transport coefficients of gaseous He, O_2, Ar, CO_2 and their binary mixtures are calculated at temperatures from 100 to 300 K and pressures from 10^6 to $6x10^6$ Pa. The comparison of calculation and the experiment avalailable in the literature is made; it is concluded that the calculation error is less than 10% in case of viscosities and within 30% for thermoconductivities. Certain well-known empirical correlations for diffusion coefficients are studied and is is demonstrated that these coefficients can be evaluated by a simple correlation with minimum error up to 30%.

30882 **(INPE—4428-TDL/308) Influence of radiation and thermal conduction on temperature distribution in the thin wall of a hollow cylinder.** Desouzasoares, A.M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Nov 1987. 77p. (In several languages). NTIS, PC A05/MF A01.

A numerical method is employed to obtain the temperature profile in the thin wall of a cylinder under solar radiation in space. The wall is conductive and the results are obtained under steady state conditions. The heat exchange mechanisms include circumferential conduction along the wall as well as thermal radiation from both inner and outer surfaces of the cylinder. The radiative terms are not linearized. Satisfactory comparisons are made with some approximate analytical results from the literature.

30883 **(N—88-18883) Transient radiative energy transfer in incompressible laminar flows. Progress report, period ending 30 June 1987.** Tiwari, S.N.; Singh, D.J. (Old Dominion Univ., Norfolk, VA (USA)). Jun 1987. 285p. (NASA-CR—182605; NAS—1.26:182605). NTIS, PC A13/MF A01.

Analysis and numerical procedures are presented to investigate the transient radiative interactions of nongray absorbing-emitting species in laminar fully-developed flows between two parallel plates. The particular species considered are OH, CO, CO_2, and H_2O and different mixtures of these. Transient and steady-state results are obtained for the temperaure distribution and bulk temperature for different plate spacings, wall temperatures, and pressures. Results, in general, indicate that the rate of radiative heating can be quite high during earlier times. This information is useful in designing thermal protection systems for transient operations.

30884 **(N—88-19739) High Rayleigh number convection in rectangular enclosures with differentially heated vertical walls and aspect ratios between zero and unity.** Kassemi, S.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Apr 1988. 21p. (NASA-TM—100277; E—3838; NAS—1.15:100277). NTIS, PC A03/MF A01.

High Rayleigh number convection in a rectangular cavity with insulated horizontal surfaces and differentially heated vertical walls was analyzed for an arbitrary aspect ratio smaller than or equal to unity. Unlike previous analytical studies, a systematic method of solution based on linearization technique and analytical iteration procedure was developed to obtain approximate closed-form solutions for a wide range of aspect ratios. The predicted velocity and temperature fields are shown to be in excellent agreement with available experimental and numerical data.

30885 (PB—88-175930/XAB) Technical assistance document: recommended record-keeping systems for air-pollution-control equipment. Part 1. Particulate matter controls. Final report. Saunders, G.; Hawks, R. (PEI Associates, Inc., Cincinnati, OH (USA)). Aug 1987. 65p. NTIS, PC A04/MF A01.

This manual describes the types of records that should be maintained for major particulate-matter control systems - multicyclones, fabric filters wet (venturi) scrubbers, and electrostatic precipitators. Records of operating parameters and maintenance activity should be part of any preventive maintenance program. Operating records can also be used to diagnose changes in equipment performance affecting the compliance status of a source. The basic elements of a record-keeping program discussed in the manual include: control equipment/process operating records, inspection checklist, inspection schedules, inspection reports, and equipment-maintenance records. Items to be recorded and tracked for each type of control equipment are listed.

30886 Mean flows and the onset of chaos in large-cell convection. Greenside, H.S.; Cross, M.C.; Coughran W.M. Jr. (Department of Computer Science and Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review Letters;* 60: No. 22, 2269-2272(30 May 1988).

Numerical simulations of two-dimensional model equations show that a coupling between amplitude and vertical-vorticity fields allows chaotic flows near the onset of Rayleigh-Benard convection in large aspect ratio domains. In cylindrical cells, mean flows arising from this coupling lead to a chaotic nucleation of dislocations that is remarkably similar to recent observations in convection experiments.

4205 Materials Testing

REFER ALSO TO CITATION(S) 30540, 30555, 30635, 30653, 30661, 30870

30887 (AERE-R—12141) Estimating the depth of intergranular attack by ultrasonic time-delay. A theoretical analysis. Temple, J.A.G. (UKAEA Harwell Lab. Theoretical Physics Div.). Nov 1987. 55p. H.M. Stationery Office, London, price Pound 5.00.

The paper presents a model of the behaviour of ultrasound in inter-granular attack, for media permeated by a random array of small cracks. The model can be used to convert measured ultrasonic time delays into depths of intergranular attack in steam generator tubing. Firstly a review is given of the results of the theory governing the propagation of elastic waves in cracked degraded material. Two simple phenomenological models for the variation of crack density with distance from the outside surface of the media are discussed. The effects of these models on the time-of-flight determination of the depth penetration of intergranular attack are examined. Finally a discussion of the results for the model is presented. (U.K.).

30888 (DOE/ER/10963—6) Review of scratch test studies of abrasion mechanisms. Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Metallurgical Engineering and Materials Science). 1986. Contract AC02-81ER10963. 16p. (CONF-840766—5). American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103. Order Number TI88008356/JAW.

From 17. annual convention of the International Metallographic Society; Philadelphia, PA, USA (15 Jul 1984).

The use of scratch tests to simulate the material removal mechanisms which occur during abrasion is reviewed. Although useful studies of the effect of the rake angle on material removal have been carried out using diamond tools, closer simulation of the mechanisms of material removal can be obtained using actual irregular individual abrasive particles as scratch tools. Previous studies are reviewed in which scratch tests have been performed with both conventional scratch test instruments and a specially designed system used for {ital in situ} scratch tests in the scanning electron microscope (SEM). Multiple-pass scratch tests over the same scratch path have been shown to create surface features and wear debris particles which are very similar to those produced by low-stress abrasion. Alumina (Al_2O_3) particles have been shown to produce continuous micromachining chips from the hard, brittle carbide phase of Stellite alloys, establishing direct cutting as the important mechanism of material removal for this type of abrasive. An {ital in situ} study of material removal from white cast irons by quartz particles has provided conclusive evidence that carbide removal does not occur by direct cutting but rather always involves microfracture. Previously unpublished work which has compared scratch tests with crushed quartz and alumina particles is included. Also described is a new scratch test system which controls the depth of cut rather than the scratch load in order to simulate high-stress abrasion, in which abrasive particles are constrained to a fixed depth of cut. Preliminary new results show substantially different carbide fracture behavior under fixed-depth conditions. 8 figs., 20 refs.

30889 (INIS-BR—1015) Measure of hydrogen concentration profile in materials by resonant nuclear reactions. Livi, R.P.; Zawislak, F.C.; Acquadro, J.C. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1986. 6p. (In Portuguese). (CONF-8609421—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702599/JAW.

From Meeting about gases in metals and alloys; Sao Carlos, Brazil (24 Sep 1986).

The technique for determining the profile of hydrogen concentration in proximities of the surface of materials, is presented. The preliminary measurements were done, using the Pelletron accelerator at Sao Paulo University (USP), in Brazil, for the resonant-nuclear reaction $^{1}H(^{19}F, \alpha\gamma)^{16}O$. By using this reaction the technique is sensitive for concentrations above 500 ppm, which could be reduced to 100 ppm through special shieldings and other techniques to reduce the background radiation. (M.C.K.).

30890 (INIS-SU—23) Device and technique for deformation experimental study up to temperature ~ 0.4 K. Kuz'menko, I.N.; Pustovalov, V.V.; Shumilin, S.Eh. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1986. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702810/JAW.

Preprint--58-86.

An original installation is described intended for the study of plastic flow below ~ 0.4 K in liquid ^{3}He. The experimental technique is presented and the optimal conditions of deformation are defined. A study is made of heat effects observed during deformation below 1 K. The capabilities of the novel installation are illustrated by examples.

30891 (LA—11131) In-flight radiographic study of two nonaxisymmetric, explosively formed penetrators. Schwalbe, L.A.;Mueller, K.H. Jr.;Christian, J.M.;DiBona, P.J. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 24p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006901/JAW.

We present in-flight radiographic images of two explosively formed penetrators (EFPs) of tantalum. The data were obtained with Ecto, a flash x-ray source that delivers a single, 50-ns pulse of radiation with an effective mean energy of 1.4{pulse}{minus} 0.1 MeV. The enrgy and flux of the beam are sufficient to penetrate the EFPs and reveal their internal structure. The subjects of this study are two warheads of an identical nonaxisymmetric design. One warhead was fired in each of two separate experiments. The warheads were oriented perpendicular to one another to provide separate orthogonal views of their EFPs. The radiographs were then digitized and subjected to several numerical analyses, which include estimates of the masses of the EFPs, their center-of-mass coordinates, and plots of the attenuation lengths (or material thicknesses) at various positions. Optical photographs were also taken of the front and profile of one EFP. The optical data aid in interpretating the radioagraphy by allowing identification of the visible external features. 3 refs., 16 figs.

30892 (RAL—88-017) Temperature measurement by neutron resonance radiography. Mayers, J.; Baciocco, G.; Hannon, A.C. (Rutherford Appleton Lab., Chilton (UK)). Mar 1988. 14p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753614/JAW.

We present a new data analysis technique for obtaining temperatures from neutron resonance radiography measurements. The technique is applied to measurements on tantalum and rhenium foils, a high temperature engineering alloy and a model catalytic system. Temperatures have been obtained to an accuracy of better than +- 1°C in the temperature range 21°C to 600°C. The results are in good agreement with theoretical simulations.

30893 (RISO-M—2672) Neutron radiography, techniques and applications. Domanus, J.C. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 32p. (CONF-880266—; CONF-8806106—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753019/JAW.

From Symposium on non-destructive evaluation; Liege, Belgium (4 Feb 1988).

After describing the principles of the "in pool" and "dry" installations, techniques used in neutron radiography are reviewed. Use of converter foils with silver halide films for the direct and transfer methods is described. Advantages of the use of nitrocellulose film for radiographying radioactive objects are discussed. Dynamic imaging is shortly reviewed. Standardization in the field of neutron radiography (ASTM and Euratom Neutron Radiography Working Group) is described. The paper reviews main fields of use of neutron radiography. Possibilities of use of neutron radiography at research reactors in various scientific, industrial and other fields are mentioned. Examples are given of application of neutron radiography in industry and the nuclear field.

30894 (SAND—88-0448) Microfocus x-ray techniques for flaw location. Guthrie, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 13p.

Two flaw location techniques are proposed using direct image magnifications from a microfocus X-ray system with ≤ 0.0004-in. focal spot and 10-160-kV capabilities. 5 refs., 2 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 30230, 30573, 30864, 30950, 30992, 30996, 31939

30895 (AD-A—189298/3/XAB) Faraday-effect light-valve arrays for adaptive optical instruments. Hirleman, E.D.; Dellenback, P.A. (Arizona State Univ., Tempe (USA). Dept. of Mechanical and Aerospace Engineering). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in Flow and Particle Diagnostics, Proceedings of ICALEO 1987(1987).

The ability to adapt to a range of measurement conditions by autonomously configuring software or hardware on-line will be an important attribute of next-generation intelligent sensors. This paper reviews the characteristics of spatial light modulators (SLM) with an emphasis on potential integration into adaptive optical instruments. The paper focuses on one type of SLM, a magneto-optic device based on the Faraday effect. Finally, the integration of the Faraday-effect SLM into a laser-diffraction particle-sizing instrument giving it some ability to adapt to the measurement context is discussed.

30896 (AD-A—189634/9/XAB) Examination of temperature effects on gate-to-drain avalanche breakdown in GaAs MESFETS (metal-semiconductor field effect transistors) by measuring light emission under rf drive. Master's thesis. Robb, R.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 161p. (AFIT/GE/ENG—87D-73). NTIS, PC A08/MF A01.

This investigation examines temperature effects on avalanche breakdown in GaAs MESFETs to determine if this failure mechanism is accelerated by high-temperature life tests. The specific objective is to assess whether the accelerated life-test evaluations performed on a GaAs MESFET planned for use in future Defense Satellite Communications System (DSCS) spacecraft have adequately addressed the reliability issues concerning the gate-to-drain avalanche breakdown failure mechanism. This objective was accomplished by adapting an existing analytical model for temperature effects, and using it to predict the variation in avalanche multiplication activity with temperature. To verify this model, it was used to calculate the associated changes in light emissions over temperature which were experimentally validated on one device of the type planned for use by the DSCS program. Once validated, these models were used to evaluate the adequacy of the accelerated-temperature life tests. The results of this evaluation indicate that the the avalanche-breakdown failure mechanism is decelerated with temperature, and therefore, the effects of avalanche breakdown on the reliability of GaAs MESFETs cannot be determined by accelerated temperature life testing.

30897 (BDX—613-3921) Evaluation of Hewlett Packard rf thermistor mounts for power linearity. Stone, D.W. (Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div.). Apr 1988. Contract AC04-76DP00613. 22p.

A method has been developed for evaluating the power sensitivity linearity of Model 478A, 478A-H75, and 8478A, thermistor mounts manufactured by Hewlet Packard Company Inc., Palo Alto. This method provides the thermistor mount power sensitivity curve as measured power approaches the maximum rated power of the thermistor mount. This characteristic is essential to the accuracy of power ratio measurements. Selection of thermistor mounts, linerar within 0.001 dB over a 15 dB range, is possible. This is a ten-fold improvement over the previous 0.01 dB value used. This improvement was required for the enhanced certification of 10 dB attenuators needed in the calibration support of attenuation measurement, power calibration, and network analyzer systems.

30898 (EPRI-EL—5657) Controller for real and reactive power modulation of HVDC systems: Final report. Pollard, E.M. (General Electric Co., Malvern, PA (USA)). Mar 1988. 91p. Research Reports Center, Box 50490, Palo Alto, CA 94303;3. Order Number TI88920238/JAW.

This report describes the microprocessor implementation and testing of the real and reactive power modulation controller specified in EPRI-EL-2101. The controller utilizes a state-space mathematical approach for the control algorithm. The optimized state matrices for the several cases studied earlier were used as the starting point for the controller described herein. A microprocessor-based implementation of those matrix equations is employed. The state equations were transformed to block diagonal form to minimize the real time computational effort required of the microprocessor. Further simplification was achieved by the use of direct recursive integration in the state reconstruction algorithm. Two basic controller designs were explored. One used a measurement of power in an ac transmission line parallel to the dc line as an input to the controller. The other employed the HVDC rectifier commutating bus frequency deviation as the controller input. Effectiveness of both designs was demonstrated by real time testing.

30899 (PB—88-861687/XAB) Laser cavity resonators. January 1975-March 1988 (citations from the Searchable Physics Information Notices data base). Report for January 1975-March 1988. (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 145p. NTIS PC N01/MF N01.

Supersedes PB—86-874831.

This bibliography contains citations concerning the design and theoretical and experimental studies of cavity resonators in lasers. Included are studies of laser spectra and tuning due to various resonators. Types of resonators include mirror, ring, and waveguide devices. (This updated bibliography contains 404 citations, 90 of which are new entries to the previous edition.)

30900 **(PB—88-862651/XAB) Semiconductor gas sensors. January 1975-April 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 69p. NTIS PC N01/MF N01.

Supersedes PB—87-858999.

This bibliography contains citations concerning the utilization of semiconductor devices as gas detectors. Topics include performance and operating characteristics of specific devices, materials descriptions, design considerations, and applications in pollution detection. Fabrication techniques are also considered. (This updated bibliography contains 129 citations, 22 of which are new entries to the previous edition.)

30901 **(SAND—87-2475C) Ion implantation processing of III-V strained-layer semiconductors.** Myers, D.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p.

Ion implantation has had a strong impact on the development of III-V strained-layer semiconductor (SLS) materials and device technologies. Implantation studies have helped delineate the present understanding of strained-layer stability and metastability limits. Resulting ion beam technologies have led to improvements in a variety of SLS discrete devices, including optoelectronic emitters, photodetectors, and field-effect transistors. Both SLS stability criteria and implanted SLS devices are reviewed with respect to future applications in optoelectronics. 36 refs., 2 figs.

30902 **(SAND—87-2768C) Designing to safe power limits in hybrid circuits.** Norwood, D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880554—1).

From 38. electronics components conference; Los Angeles, CA, USA (9 May 1988).

In this work, experiments were performed at two heat transfer conditions simulating minimum and maximum heat transfer. Since hybrid circuit heat dissipation is dependent on factors such as heat sinking, package design, substrate material, environment and other considerations, it was decided to bracket the extremes of power dissipation for hybrid circuits. Tests performed at these two heat transfer conditions yielded data which was used to form relationships between the hybrid variables of temperature, size, and power. To establish these relationships, the various sizes of resistors and hybrid substrates were accommodated by forming a ratio of resistor to substrate size; this ratio was then used to relate the variables of power density and temperature. Both resistor and substrate temperature were predictable within the desired temperature limits of 0 to 300 degrees C using the relationships developed. Finally, the data and relationships shown graphically were converted to equation form making it possible to incorporate them into computer design programs. The power-temperature relationships developed make possible the predictions of both resistor and substrate temperatures at circuit design. This is both necessary and advantageous for design of hybrid circuits having increased power and circuit density. The work presented is not intended as a universal guide for designing circuits to safe power limits, rather, it should serve as a example or model for establishing power limits applicable to specific hybrid technologies. 2 refs., 13 figs., 2 tabs.

30903 **(SAND—87-3112) The first synthesis of chem-prep varistor LAC [lightning arrestor connector] granules.** Tuttle, B.A.; Voigt, J.A.; Andrews, L.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 25p.

ZnO variestor granules are the active medis for many lightning arrestor connectors (LACs). The 150 to 200 micron diameter granules provide a controlled electrical breakdown in the 400 micron gap between the electrically conductive pin and web of the connector. Tradiationally, the varistor granules are made from commercially available, reagent grade, mixed oxide powders that range in particle size from 1 to 20 microns. For the first time, we have synthesized varistor granules from chemically prepared powders developed at Sandia. These chem-prep varistor powders are more homogeneous and much finer than the mixed oxide powders; the mean particle size of the chem-prep powders is approximately 0.06 microns. LAC granules were formed from chemically prepared powders by traditional ceramic processing techniques. Although the chem-prep granules were not as spherical as the mixed oxide granules, the chem-prep granules did meet present LAC component requirements for fast-rise breakdown voltage and insulation resistance. The insulation resistance of chem-prep granules for a 200 volt pin-to-web voltage was 100 times less than for mixed oxide granules; however, both types of granules had similar insulation resistance for a 250 volt pin-to-web voltage.

30904 **(SAND—87-7173C) Monolithic GaAs Ku-band one watt constant phase variable power amplifier.** Pritchett, S.D. (Sandia National Labs., Albuquerque, NM (USA)). May 1988. Contract AC04-76DP00789. 4p. (CONF-880565—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006272/JAW.

From IEEE MTT-S international microwave symposium; New York, NY, USA (25 May 1988).

A GaAs monolithic Ku-band 1.0 Watt constant phase variable power amplifer has been demonstated. Compressed gain is greater than 14 dB and 1.0 Watt output powerr over a 13.5 to 15.5 GHz band. More than 30 dB of gain control with < +- 10{degree} of phase variation has been demonstrated.

30905 **Overshoot in the response of a photoconductor excited by subpicosecond pulses.** Iverson, A.E.; Wysin, G.M.; Smith, D.L.; Redondo, A. (Electronics Research Group, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **52**: No. 25, 2148-2150(20 Jun 1988).

Experiments designed to observe velocity overshoot in GaAs photoconductors excited by 2.0 eV photons are discussed. Monte Carlo transient velocity computations are presented which indicate that, for 620 nm (2.0 eV) excitation of GaAs, velocity overshoot will not occur for fields less than 20 kV/cm. Photoconductive device model equations are solved numerically for the case of subpicosecond-pulse excitation. The computed photoconductor response is observed to have an overshoot on the picosecond time scale resulting from charge-separation effects. The overshoot behavior is very similar to that observed in measurements of subpicosecond photoconductor response and previously interpreted in terms of velocity overshoot. We conclude that experimentally observed overshoot response at 620 nm is the result of charge-separation effects and not the result of velocity overshoot.

30906 **Analysis of anomalous resistivity during the conduction phase of the plasma erosion opening switch.** Kulsrud, R.M.; Ottinger, P.F.; Grossmann, J.M. (Naval Research Laboratory, Washington, D.C. 20375). *Physics of Fluids;* **31**: No. 6, 1741-1747(Jun 1988).

During the conduction phase of the plasma erosion opening switch, the current channel width, in the body of the plasma away from the electrodes, has been observed to be many times wider than the collisionless skin depth. Anomalous collisions have been invoked to explain this discrepancy. Here the problem is analyzed using an electrostatic Vlasov approach, and an unstable ion acoustic mode is identified. The derived growth rate is fast enough and the nonlinear saturation level is high enough to explain the observed magnetic field penetration.

30907 **Electrical breakdown in a fuse network with random, continuously distributed breaking strengths.** Kahng, B.; Batrouni, G.G.; Redner, S.; de Arcangelis, L.; Herrmann, H.J. (Center for Polymer Studies and Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review [Section] B: Condensed Matter;* **37**: No. 13, 7625-7637(1 May 1988).

We investigate the breakdown properties of a random resistor-fuse network in which each network element behaves as a linear resistor if the voltage drop is less than a threshold value, but then "burns out" and changes irreversibly to an insulator for larger voltages. We consider a fully occupied network in which each resistor has the same resistance (in the linear regime), and with the threshold voltage drop uniformly distributed over the range $v\sqrt{} = 1\text{-}w2$ to $v\mu = 1+w2$ ($0<w\leqq 2$). The breakdown properties of this

model depend crucially on w, and also on L, the linear dimension of the network. For sufficiently small w, "brittle" fracture occurs, in which catastrophic breaking is triggered by the failure of a vanishingly small fraction of bonds in the network. In this regime, the average voltage drop per unit length required to break the network, <v/sub b/>, varies as v√+O(1L²), and L→∞, and the distribution of breakdown voltages decays exponentially in v/sub b/. By probabilistic arguments, we also establish the existence of a transition between this brittle regime and a "ductile" regime at a critical value of w = w/sub c/(L), which approaches 2, as L→∞. This suggests that the fuse network fails by brittle fracture in the thermodynamic limit, except in the extreme case where the distribution of bond strengths includes the value zero. The ductile regime, w>w/sub c/(L), is characterized by crack growth which is driven by increases in the external potential, before the network reaches the breaking point.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 30162

4220 Underground Engineering

30908 **(AD-A—189791/7/XAB) Experimental and theoretical response of multiphase porous media to dynamic loads. Annual report No. 2, 1 July 1986-30 June 1987.** Kim, K.J.; Blouin, S.E.; Timian, D.A. (Applied Research Associates, Inc., South Royalton, VT (USA). New England Div.). 24 Sep 1987. 308p. (ARA—5967-87). NTIS, PC A14/MF A01.

This report summarizes results of a combined theoretical and experimental investigation of wave propagation and liquefaction from high-intensity dynamic loading of saturated porous media. This work presents results obtained during the second year of a three-year research effort. Theoretical derivations describing undrained hydrostatic and uniaxial strain loadings were obtained and incorporated into a numerical code (NKOCP) which models the two-phase undrained response of saturated soils and rocks. Numerical calculations of the response of saturated rock and soil compare very well with laboratory data in which both the soil and rock are liquefied during the unload portion of the cycle. Theoretical and numerical solutions for the speed and damping of waves of the first and second kind in fully coupled two-phase media are also presented. Parameter studies of the influence of frequency and variations in material properties on wave speed and damping are performed.

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 31057, 31059

30909 **(PB—88-172226/XAB) Industrial Combustion Emissions (ICE) model, Version 6.0. Model-Simulation.** Elliott, D.J.; Hogan, T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Dec 1987. mag tap. (EPA—600/8-88/007B). NTIS CP T11.

Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—88-172234.

The Industrial Combustion Emissions (ICE) Model was developed by the Environmental Protection Agency for use by the National Acid Precipitation Assessment Program (NAPAP) in preparing future assessments of industrial-boiler emissions. The ICE Model user's manual includes a summary of user options and software characteristics, a description of the input data files, and a description of the procedures for operation of the ICE Model. Proper formatting of files and creation of job-control language are discussed. The ICE Model projects for each State the sulfur dioxide, sulfates, and nitrogen oxides emissions from fossil fuel combustion in industrial boilers. Projections of emissions and costs of boiler generation, including emission-control costs, are projected for the years 1985, 1990, 1995, 2000, 2010, 2020, and 2030.

30910 **(PB—88-172234/XAB) Industrial Combustion Emissions (ICE) model, Version 6.0. User's manual. Report for November 1984-August 1987.** Hogan, T. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Feb 1988. 78p. NTIS, PC A05/MF A01.

For system on magnetic tape, see PB—88-172226.

This report is a user's manual for the Industrial Combustion Emissions (ICE) model. It summarizes user options and software characteristics, and describes both the input data files and procedures for operating the model. It discusses proper formatting of files and creation of job-control language. The model projects for each state the emissions of sulfur oxides, sulfates, and nitrogen oxides from fossil-fuel combustion in industrial boilers. Emissions and costs of boiler generation, including emission-control costs, are projected for the years 1985, 1990, 1995, 2000, 2010, 2020, and 2030.

30911 **(PB—88-173356/XAB) Promising technologies for the biological detoxification of hazardous waste.** Glaser, J.A. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Feb 1988. 14p. (EPA—600/D-88/040). NTIS, PC A03/MF A01.

There are, under development, a number of new biological technologies that target the cleanup of contaminated hazardous-waste sites. These technologies utilize specific organisms to degrade organic chemical contaminants to less toxic species. The attraction to the new area of treatment in the United States is the restrictions on waste burial, costs of conventional alternative technology, and the assumption that biological processes are more environmentally benign. Two areas of development discussed in the paper are the use of white-rot fungus wood degrader for water and soil treatment and a pentachlorophenol degrader. The white-rot-based treatment is focused on the treatment of wood-treating wastes, i.e., creosote, pentachlorophenol, and associated materials.

30912 **(PB—88-177159/XAB) Fundamental mechanisms governing transients from the batch incineration of liquid wastes in rotary kilns. Report for February 1987-February 1988.** Wendt, J.O.L.; Linak, W.P.; McSorley, J.A. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Mar 1988. 58p. NTIS, PC A04/MF A01.

This paper provides insight into why (for liquid wastes) puffs are very easily generated and why their magnitudes and intensities increase with increasing kiln temperature and rotation speed; and how the generation of puffs in general is controlled by waste properties, sorbent properties, and kiln operating parameters. A theoretical model describing simultaneous heat and mass transfer into a sorbent aggregate, coupled with vapor-pressure-driven waste vaporization within the sorbent aggregate, was combined with a fragmentation model and was able to qualitatively predict experimentally observed effects relating to puff duration, kiln speed rotation, kiln temperature, and stoichiometric oxygen requirement of the waste. These theoretical results support data from an EPA rotary-kiln incinerator simulator.

30913 **(PB—88-180120/XAB) Operation and maintenance manual for fabric filters.** (PEI Associates, Inc., Cincinnati, OH (USA)). Jun 1986. 238p. NTIS, PC A11/MF A01.

The manual presents a general description of fabric-filter types and examines their applicability to varying gas-stream conditions and particulate characteristics. The manual discusses the use of performance monitoring and other information to evaluate equipment performance, diagnose real or impending problems, and troubleshoot problem and malfunction causes. Tracking procedures and trends-analysis methods that can be used to assess current or impending deterioration in performance are also discussed. Problem diagnosis and potential corrective measures are described. Guidelines are presented for general operation and maintenance practices and procedures for use in improving and sustaining fabric filter performance and reliability. The manual presents methods and procedures for detailed inspections of fabric filter systems and their components. It provides step-by-step procedures and techniques for conducting external and internal inspections at both large and small fabric-filter installations. Inspection during the pre-operational con-

struction phase and the performance demonstration (baselining) period are also addressed.

30914 **(PB—88-185277/XAB) Corrective measures for releases to soil from solid-waste-management units. Draft report (Final).** Konieczny, S.C.; Farrell, L.; Gosse, M.M.; Myatt, B.; Kay, B. (Alliance Technologies Corp., Bedford, MA (USA)). Aug 1985. 207p. (GCA-TR—85-66-G). NTIS, PC A10/MF A01.

Upon discovery of a release from a solid-waste-management unit at a Resource Conservation and Recovery Act (RCRA) facility, a complete site investigation should be performed to determine nature and extent of the release. Once the release and its extent has been characterized, and determined to be a threat to human health or the environment, corrective measures must be implemented. The draft final report discusses the various types of removal/containment (includes disposal) and treatment technologies applicable to remediation of releases to soils.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 30969, 31210, 31495

30915 **(BNL—40871) The relativistic heavy ion collider project: A status report.** Ludlam, T.W.; Samios, N.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-8708202—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007043/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (24 Aug 1987).

This paper discusses the present status of the Brookhaven Relativistic Heavy Ion Collider (RHIC) accelerator. Basic parameters of the facility are discussed. Detectors and experiments are reviewed briefly. 13 refs., 5 figs., 1 tab.

30916 **(BNL—41030) Design and construction status of the AGS Booster accelerator.** Weng, W.; Lee, Y.Y. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 13p. (CONF-880263—1).

From Accelerator design workshop; Los Alamos, NM, USA (17 Feb 1988).

To meet the requirements of new experiments in high energy physics and nuclear physics, a fast cycling Booster accelerator was proposed to fulfill the following three technical objectives: The AGS Booster has three objectives. They are to increase the space charge limit of the AGS, to incrase the intensity of the polarized proton beam by accumulating many linac pulses (since the intensity is limited by the polarized ion source), and to re-accelerate heavy ions from the BNL Tandem Van de Graaff before injection iinto the AGS. The machine is capable of accelerating protons at 7.5 Hertz from 200 MeV to 1.5 GeV or to lower final energies at faster repetition rates. The machine will also be able to accelerate heavy ions from as low as 1 MeV/nucleon to a magnetic rigidity as high as 17.6 Tesla-meters with a one second repetition rate. As an accumulator for polarized protons, the Booster should be able to store the protons at 200 MeV for several seconds. We will report primarily those design and construction issues related to high intensity proton acceleration of the Booster. 4 refs., 6 figs., 4 tabs.

30917 **(BNL—41102) Polarized proton acceleration at the BNL AGS, 1988.** Ahrens, L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 7p. (CONF-880263—2).

From Accelerator design workshop; Los Alamos, NM, USA (17 Feb 1988).

The present status of the polarized proton acceleration at the Brookhaven AGS is described. Some details regarding the tune-up and performance during the December 1987-January 1988 physics run are given. 2 refs., 4 figs.

30918 **(DOE/ER—0363) Superconducting Super Collider.** (USDOE, Washington, DC). Apr 1988. 30p.

This paper briefly reviews the needs, costs and requirements of the proposed Superconducting Super collider. (LEW)

30919 **(FNAL-TM—1516) A 3 TeV on 3 TeV proton-proton dedicated collider for Fermilab.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Mar 1988. Contract AC02-76CH03000. 13p.

The Fermilab Dedicated Collider proposed in May 1983 is a 2 TeV on 2 TeV p{bar p} collider. The expected luminosity is {approximately} 10^{31} cm/sup (minus/2}sec/sup {minus/1} and the estimated cost is {approximately} $362M (FY-83 dollars). Since 1983 both the superconducting magnet and the particle detector technologies have advanced and the countenance of physics, hence the desired characteristics of new facilities have also altered somewhat. We want to show here that with the new magnet technology used for the SSC one can construct a 3 TeV on 3 TeV pp collider on the Fermilab site. This pp Dedicated Collider)PPDC) will have a luminosity of about 10_{33}cm/sup {minus/2}sec{sup{minus}1} and a cost only {approximately} 50{percent} more than that of the p{bar p} Dedicated Collider, 3 figs.

30920 **(FNAL-TM—1520) Studies of one-campus and two-level configurations for SSC.** Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 29 Apr 1988. Contract AC02-76CH03000. 24p.

In this report we investigate in some detail the geometry and the cost of two modifications in the configuration of the SSC. 3 refs., 7 figs.

30921 **(FNAL-TM—1522) Application of the Argonne Advanced Acceleration Test Facility to development for conventional accelerators.** MacLachlan, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 7 Apr 1988. Contract AC02-76CH03000. 9p.

The Argonne Advanced Acceleration Test Facility is designed as a powerful tool to test ideas for very high gradient acceleration schemes based on direct beam excitation of plasmas, metal structures, dielectrics, etc. The characteristic size in these systems is {approximately} 1 cm, corresponding to frequencies {approximately} 10 GHz. The question addressed here is whether the special features of this facility have application as well to the development of components for the more conventional, lower frequency, accelerators now operating or under development. It is suggested that the usefulness of the facility for the development of conventional systems could be enhanced by a provision for longer time delay between driver and witness beam pulses. 9 refs., 2 figs.

30922 **(INPE—4242) Proposal for constructing the energetic particle injector.** Ueda, M.; Ferreira, A.C.A.; Aso, Y. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Jul 1987. 35p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702814/JAW.

The construction of an electrostatic accelerator to produce an intense ion beam is proposed. The high voltage pulse to be used in the acceleration of the ions (500 kV, 1 μs) will be provided by a Marx generator. Using this pulses, a high total current proton beam (>200 KA) will be extracted from a magnetically insulated diode with an anode plasma produced by an inductive breakdown of hydrogen gas. The beam will be injected into a magnetic confinement device, a tokamak to be called ETA (Experimento Toroidal Avancado), to study heating, refueling and noninductive current generation in toroidal plasmas.

30923 **(LA-UR—86-3320) Computer codes used in particle accelerator design: First edition.** (Los Alamos National Lab., NM (USA)). 1 Jan 1987. Contract W-7405-ENG-36. 199p.

This paper contains a listing of more than 150 programs that have been used in the design and analysis of accelerators. Given on each citation are person to contact, classification of the computer code, publications describing the code, computer and language runned on, and a short description of the code. Codes are indexed by subject, person to contact, and code acronym. (LEW)

30924 **(LA-UR—88-1348) Technical summary of the accelerator design workshop, 22-27 February 1988.** Thiessen, H.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880263—3).

From Accelerator design workshop; Los Alamos, NM, USA (17 Feb 1988).

This paper contains a short summary on accelerator designs. Kaon factory, boosters, polarized beams and power supplies are all briefly mentioned.

30925 **(SLAC-PUB—4564) Electron-positron physics at 1 TeV.** Feldman, G.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515. 24p. (CONF-871071—3).

From 8. Vanderbilt high energy physics conference; Nashville, TN, USA (8 Oct 1987).

We discuss the motivation for TeV e^+ e/sup {minus/} linear colliders, some aspects of their design, and the experimental consequences that follow from the design. After a brief discussion of the general physics environment, we consider the discovery potential of these colliders by examining three sample processes: the detection of new heavy leptons, standard Higgs bosons, and charged Higgs bosons. 13 refs., 22 figs., 5 tabs.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 30935

30926 **(BNL—40784) An optical technique for measuring divergence, beam profile, and aiming direction, of relativistic negative hydrogen ions.** Hershcovitch, A. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. Contract AC02-76CH00016. 4p. (CONF-880256—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007049/JAW.

From 3. European workshop production and applications of light negative ions; Amersfoort, Netherlands (17 Feb 1988).

A novel, nonobstructive diagnostic technique for high energy H/sup minus/D/sup minus/ ion beams is described. This scheme employs spectroscopic techniques designed to measure beam profile, perpendicular velocity spread (i.e., divergence), and orientation of multiMeV H/sup minus/ beams. The basic principle of this method is to photoneutralize a small portion of the H/sup minus/ beam in a way such that the photodetachment process results in the formation of excited hydrogen atoms in the n = 2 levels. Observation of fluorescence from spontaneous decay of H(sp) andor induced deacy of H(2s) can be readily used to determine beam profile. Doppler broadening measurements can be used to determine velocity spread from which beam emittance is calculated. With off-the-shelf instruments resolutions of 1 mm for beam profile and 2 x 10/sup minus/2} π cm-mrad are possible. For photodetachment, the best commercially available laser is found to be ArF eximer laser. The analysis is performed for the 200 MEV BNL Linac. The laser, which has a pulse duration which has a pulse duration which is of 10/sup minus/5} of the linac can produce sufficient signal at a negligible beam loss. In addition, measurements of minute Doppler shifts of this Lyman-Alpha radiation by a spectrograph could in principle resolve beam direction to within 1.57 μrad. The process under consideration has a resonance known as the shape resonance. As the following literature review indicates, the total cross section is known and there is a reasonable agreement between theory and experiment. There are no experimental measurements of partical cross sections. nevertheless, there are theoretical estimates which agree within 15%. 10 refs., 1 fig.'

30927 **(DOE/ER/40216—5) Accelerator research studies: Annual progress report.** (Maryland Univ., College Park (USA)). 5 Mar 1988. Contract AC05-85ER40216. 62p.

Our major goal in this experiment is to study the physics of a space-charge dominated beam propagating through a long, periodic transport channel consisting in our case of 38 solenoid lenses two of which are being used to match the beam from the gun into the periodic lattice. In addition, a small separate test stand gives us the capability of studying different electron gun designs including measurements of beam perveance and emittance, beam propagation in drift space and through a single solenoid lens. Most of our transport studies in the periodic channel have been conducted with a 5 keV, 200 mA electron beam from a gun with a 1-inch diameter thermionic cathode. The beam physics phenomena of greatest interest are instabilities due to resonant interaction between the beam and the periodic lattice, non-linear effects due to external forces (e.g., spherical lens aberrations) or due to nonuniform charge distributions, beam off-centering and misalignments which also include the effects of image forces. In principle, all of these effects may lead to emittance growth and beam loss. An important question is whether there exists a "window" of 100% transmission and minimal emittance growth in such a long periodic channel. 28 refs.

30928 **(DOE/ER/40302—1) Particle dynamics in a wave with variable amplitude: Annual progress report, August 1, 1987-April 30, 1988.** Cary, J.R. (Colorado Univ., Boulder (USA)). Jan 1988. Contract FG02-86ER40302. 110p.

Analysis of accelerator systems via newly developed techniques of nonlinear dynamics has been carried out. The study of transport through phase psace over the last year has clarified the effects of correlations on the dynamics of systems with slow chaos. An analytic alculation of the relation between the phases between separatrix crossings allows more accurate calculation of the rate of diffusion for particle throughout phase space. Numerical calculations show nevertheless that predictions obtained by the neglect of correlations are qualitatively correct. A new method for obtaining the dynamic apeture in accelerators has also been developed. The results from analyzing one-dimensional systems are encouraging. 11 refs., 3 figs.

30929 **(FNAL-TM—1510) Space-charge effects in the Main Ring at 8 GeV.** Mane, S.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 21p.

This is a note on the effects of space-charge on particle behavior in the Main Ring. At first, to elucidate various basic points, an idealized model of the Main Ring was studied. Then the TEVLAT program was used, with a sample Main Ring lattice. The TEVLAT program was modified to include space-charge kicks. The idealized model mentioned above consisted of linear dynamics with localized nonlinear elements (thin sextupoles). The incoherent space-charge force was included as a series of kicks applied uniformly around the ring (because the space-charge force is not localized). The space-charge force changes the tune and the oscillation amplitude (action variable) of a particle. However, the effect of this was not fed back into the beam emittance (and thus the change to the space-charge force itself). Finally, synchrotron oscillations were included, and some brief results are presented. 2 refs., 12 figs.

30930 (INIS-BR—1018, pp 37) **Linear model for accurate determination of lattice constant and crystal orientation by the divergent-beam technique.** Keller, W.A.; Ratajczyk, E.; Sarnecki, T. (Bahia Univ., Salvador (Brazil). Inst. de Fisica). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

30931 **(LA—11263-MS) Parameter scaling to produce different charged-particle beam-transport systems having identical equations of motion.** Wadlinger, E.A. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 22p.

Designs are freuently required for charged-particle optics channels to transport space-charge (Coulomb) force-dominated beams for use with accelerators under design or construction. It is often desirable to experimentally test a design using an existing accelerator having different parameters from the one under consideration. This paper shows how to scale a charged-particle transport design to make a model experiment for testing the design with an existing accelerator. Sometimes, with the proper choice of accelerator, the model experimetn can be much less expensive than the target device. By scaling variables (beam current and emittance, magnetic fields, etc.) in a way that produces certain invariant quantities, we obtain identical equations of motion for different charged-

particle beam channels transporting different beams. The scaling relations take a transport channel design for one application having a given time structure (for instance, the time structure determiend by the radio frequency of a beam bunching cavity), beam energy, current, etc., and determine an equivalent transport channel design for another device with different parameters. Therefore, we can predict particle and beam behavior in one situation by knowing it in another. Even growth in emittance will be modeled correctly in spite of the fact that the devices transport beams with different time structure, energy, and currents. 2 refs., 1 fig., 1 tab.

30932 **(SLAC/AP—67) On the luminosity of heteroenergetic colliding-beam storage rings.** Rees, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1988. Contract AC03-76SF00515. 6p.

We shall estimate how the luminosity of a heteroenergetic colliding-beam storage-ring system is likely to be restrained by the incoherent beam-beam limit - or, in other words, by the tune-shift limit.

30933 **Quantum beamstrahlung from ribbon pulses.** Blankenbecler, R.; Drell, S.D. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* 37: No. 11, 3308-3319(1 Jun 1988).

In this paper the high-energy expansion introduced in our previous paper is used to describe the problem of beamstrahlung due to an extended pulse with an elliptical cross section of arbitrary eccentricity. We show that the transverse geometry of the pulse enters in a remarkably simple scaling manner. This case is of interest because the radiative energy loss can be markedly reduced while simultaneously keeping a fixed luminosity if the beam pulses are very thin in one transverse direction, i.e., shaped like ribbons. Effects of other types of beam shaping are briefly discussed and the physics of the process is emphasized.

30934 **Direct measurement of beam-induced fields in accelerating structures.** Figueroa, H.; Gai, W.; Konecny, R.; Norem, J.; Ruggiero, A.; Schoessow, P.; Simpson, J. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* 60: No. 21, 2144-2147(23 May 1988). Contract W-31-109-ENG-38.

We have developed a new method for measuring the electromagnetic fields (wake fields) induced in high-frequency accelerating devices by intense relativistic electron bunches. These fields are probed by a second collinear electron bunch which follows the primary bunch at a variable delay. Initial results for several iris-loaded rf structure geometries are presented. This technique is expected to be important for the study of new acceleration methods such as the plasma wake-field accelerator. Another possible application is the measurement of parasitic wakes in conventional accelerator components.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 30865, 30948, 31947, 31953

30935 **(AD-A—189139/9/XAB) Gas-delivery system and beamline studies for the test-beam facility of the Collider Detector at Fermilab. Final report, 1 July-6 November 1987.** Franke, H.G. (Army Military Personnel Center, Alexandria, VA (USA)). Dec 1987. 245p. NTIS, PC A11/MF A01.

A fixed-target test-beam facility was designed and constructed at the Meson Test (MT) site to support studies of components of the Collider Detector at Fermi National Accelerator Laboratory (CDF) the design and construction of the test-beam facility gas-delivery system is described with the initial studies to document the ability of the MT beamline to meet the needs of the collider detector facility. Analysis of the preliminary energies performance data on MT beamline components and beam tunes at required particle energies is presented. Preliminary studies show that the MT beamline has the necessary flexibility to satisfy most requirements now.

30936 **(ANL—88-7) Insertion device and beam line plans for the Advanced Photon Source: A report and recommendations by the Insertion Device and Beam Line Planning Committee.** (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 19p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006614/JAW.

In the 7-GeV Advanced Photon Source (APS) Conceptual Design Report (CDR), fifteen complete experimental beam lines were specified in order to establish a representative technical and cost base for the components involved. In order to optimize the composition of the insertion devices and the beam line, these funds are considered a "Trust Fund." The present report evaluates the optimization for the distribution of these funds so that the short- and long-term research programs will be most productive, making the facility more attractive from the user's point of view. It is recommended that part of the "Trust Fund" be used for the construction of the insertion devices, the front-end components, and the first-optics, minimizing the cost to potential users of completing a beam line. In addition, the possibility of cost savings resulting from replication and standardization of high multiplicity components (such as IDs, front ends, and first-optics instrumentation) is addressed. 2 refs., 5 tabs.

30937 **(ANL—88-9) Characteristics of the 7-GeV advanced photon source: A guide for users.** Shenoy, G.K.; Viccaro, P.J.; Mills, D.M. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006615/JAW.

In this document we present the characteristics of the electromagnetic radiation from various types of sources on the 7-GeV Advanced Photon Source (APS) storage ring. The sources include bending magnets, undulators, and wigglers. The characteristics are compared with those of other synchrotron sources when operated at their design specifications. The influence of positron beam size on the on-axis brilliance is discussed, along with the power distribution from these sources. The goal of this document is to provide users with enough information on the characteristics of radiation from the APS storage ring so that experiments can be efficiently planned. 23 refs., 20 figs., 8 tabs.

30938 **(BNL—40651) Proceedings:.** Sidhu, S.S. (comp.). (Brookhaven National Lab., Upton, NY (USA)). Dec 1987. Contract AC02-76CH00016. 80p. (CONF-8708145—).

From Workshop on model based accelerator controls; Upton, NY, USA (16 Aug 1987).

With increasingly stringent requirements on the performance of accelerators and storage rings, there is a wide interest in modeling-based control. The organizers recognized the need to have an overview and discussion on the current status of modeling-based accelerator control and how advances in computer technology, software engineering, and expert systems can impact control and diagnosis. As a result, a workshop was organized at the Brookhaven National Laboratory on August 17-18, 1987. It was made possible by the joint support of the AGS, NSLS and Applied Mathematics Departments of BNL. The talks and discussions were divided into three main topics: elements of modeling, knowledge representation, and integration of modeling-based control systems with AI and workstations. This volume is the unedited collection of papers, presented at the Workshop. Separate abstracts were prepared for 10 papers in these proceedings.

30939 **(FNAL-TM—1496) Injection septum magnets for the Loma Linda medical accelerator.** Satti, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 22 Sep 1987. Contract AC02-76CH03000. 4p. (CONF-870901—31).

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The injection beamline runs over the last magnet before a long straight section and is then displaced downward 55.88 cm to the accelerator beamline. The displacement is magnetic and the final deflection onto the synchrotron orbit is by an electric kicker. The first component, the reverse septum magnet, bends the injection beam 25{degree} downward. This is followed by the injection septum (20{degree} bend upward) and the final injection kicker (5{degree} bend upward). The septum magnets produce a peak

field of 3.4 K gauss at a current of 28,000 amperes within a 0.1 msec long pulse. The electric kicker produces a field of 7.3 KV/cm with a pulse length of 0.0011 msec. The septum magnets are similar to each other in construction with a bending radium of 72.7 cm. The curvature is required to increase the effective aperture. Each magnet has a single-turn copper coil bonded to a stainless steel plate for reinforcement. This eliminates insulating material, which could be subject to radiation damage, at the septum. The stainless steel plate is welded to the magnet laminations. The current is confined to the septum by the insulation between the laminations, which are a standard core material. The total septum thickness with shield is 1.227 cm. Pulsing the magnet eliminates the need for water cooling. 2 refs., 4 figs.

30940 **(FNAL-TM—1509) Ramping of solid iron analysis magnets in experimental areas: BM109 preliminary results.** Visser, A.T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 15 Jan 1988. Contract AC02-76CH03000. 12p.

The long main ring TeV pulse period of 60 sec with a 20 sec flattop makes it attractive to ramp solid iron magnets, such as BM109's, etc., in synchronisms with the main ring pulse. Annual energy cost savings for a BM109 could be up to a maximum of $6.6 per hour or %58,000 per year. Are there 10 or more magnets we could ramp? What is the lag between the magnet excitation current and the magnet field? It is probably small because these magnets have large air gaps and therefore relatively short (short of one second) time constants. Some preliminary measurements showing the lag between the excitation current and the magnet field for a BM109 are included. Ramping BM109's seems practical if they are programmed up to 5 seconds ahead of the main ring pulse. Maybe ramping BM109's should be tried at a few locations to gain some experience. 4 figs.

30941 **(FNAL-TM—1513) 2-Dimensional studies of the disk-and-washer and side-coupled resonant cavity structures.** Larry, L.D. Jr. (Fermi National Accelerator Lab., Batavia, IL (USA)). Dec 1987. Contract AC02-76CH03000. 94p. NTIS, PC A05/MF A01;1; GPO Dep. Order Number DE88007497/JAW.

The work done consists of three parts: optimizing the disk-and-washer (DAW) structure at $\beta = 0.5662$ corresponding to E = 200 MeV; comparing the DAW structure with the side-coupled (SCS) structure at various values of beta, ranging from $\beta = 0.4569$ and E = 116 MeV to $\beta = 0.7131$ and E = 400 MeV; and re-optimizing the DAW structure at $\beta = 0.7131$. 4 refs., 51 figs., 41 tabs.

30942 **(INPE—4076) Microwave open resonators for gyrotrons.** Barroso, J.J.; Montes, A. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)). Dec 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702813/JAW.

Weakly irregular waveguides which, under appropriate conditions, can be considered as open resonators, are studied. Through the analysis of a variety of resonators, its is discussed the influence of the cavity geometry on the longitudinal electric field distribution, aiming toward optimum field profiles with associated high efficiency operation. Open resonators operating in the mode TE_{021} are presented, which have been designed for a 35 GHz gyrotron under construction at INPE.

30943 **(JINR-R—9-87-258) Effects of space charge of high-current relativistic beam during injection in compressor.** Beloshitskij, P.F.; Perel'shtejn, Eh.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702831/JAW.

Submitted to the journal Vopr. At. Nauki i Tekh., ser.: Tekh. fiz. ehksp. .

The longitudinal instability during the injection of relativistic electron beam in slightly focussing magnetic field is studied by numerical method. Decreasing of mean radius, increasing of cross section dimensions and selfcapture of the ring are shown. 7 refs.; 7 figs.

30944 **(LBL—23123) SSC [Superconducting Super Collider] magnet technology.** Taylor, C. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 6p. (CONF-870901—30). NTIS, PC A; 02; GPO Dep. Order Number DE88007386/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

To minimize cost of the SSC facility, small-bore high field dipole magnets have been developed;some of the new technology that has been developed at several U.S. national laboratories and in industry is summarized. Superconducting wire with high J/sub c/ and filaments as small as 5μm diameter is not produced iwht mechanical properties suitable for reliable cable production. A variety of collar designs of both aluminum and stainless steel have been used in model magnets. A low-heat leak post-type cryostat support system is used and a system for accurate alignment of coil-collar-yoke in the cryostat has been developed. Model magnets of 1-m, 1.8 m, 4.5 m, and 17 m lengths have been build during the past two years. 23 refs., 5 figs., 2 tabs.

30945 **(NAC—86-05) Feasibility study for converting existing accelerator facilities for high energy ion-implantation.** Pretorius, R.; McMurray, W.R. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1986. 19p. CSIR, National Accelerator Centre, P O Box 72, Faure, 7131, South Africa.

An investigation into the need for a high energy ion-implantation facility in South Africa was recently undertaken. The aquisition of an accelerator for ion-implantation up to energies of 3 MeV was recommended and the cost of such an accelerator was estimated. The use of high energy implantation in device processing has in recent years enjoyed increasing attention. This study has shown that existing accelerators in South Africa cover the energy range of approximately 300 KeV and 3 MeV, and that it would be feasible to use such accelerators for high energy ion-implantation.

30946 **(SAND—87-3072) Computer compensation for cable signal degradations.** Boyer, W.B. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 47p.

This paper describes two techniques for computing software cable compensation filters. These filters are used in correcting waveforms recorded from diagnostics on pulsed power accelerator. Applicable topics in continuous and discrete linear systems theory are reviewed. The first technique for computing a compensation function consists of recursively solving a discrete time domain convolution equation using measured undegraded and cable degraded pulses. The second tecnique computes the compensation function in the frequency domain using an analytical model of the cable frequency response and a constrained inverse filter. Detailed procedurs are described for computing cable compensation filters using an interactive data manipulation and hardware control program. 6 refs., 24 figs.

30947 **(SLAC-PUB—4546) Breakdown phenomena in high power klystrons.** Vlieks, A.E.; Allen, M.A.; Callin, R.S.; Fowkes, W.R.; Hoyt, E.W.; Lebacqz, J.V.; Lee, T.G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515. 6p. (CONF-880687—3). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007882/JAW.

From 13. international symposium on discharges and electrical insulation in vacuum; Paris, France (27 Jun 1988).

In the course of developing new high peak power klystrons at SLAC, high electric fields in several regions of these devices have become an important source of vacuum breakdown phenomena. In addition, a renewed interest in breakdown phenomena for nanosecond pulse, multi-megavolt per centimeter fields has been sparked by recent R and D work in the area of gigawatt RF sources. The most important regions of electrical breakdown are in the output cavity gap area, the RF ceramic windows, and the gun ceramic insulator. The details of the observed breakdown in these regions, experiments performed to understand the phenomena and solutions found to alleviate the problems will be discussed. Recently experiments have been performed on a new prototype R and D

klystron. Peak electric fields across the output cavity gaps of this klystron exceed 2 MV/cm. The effect of peak field duration (i.e. pulse width) on the onset of breakdown have been measured. The pulse widths varied from tens of nanoseconds to microseconds. Results from these experiments will be presented. The failure of ceramic RF windows due to multipactor and puncturing was an important problem to overcome in order that our high power klystrons would have a useful life expectancy. Consequently many studies and tests were made to understand and alleviate window breakdown phenomena. Some of the results in this area, especially the effects of surface coatings, window materials and processing techniques and their effects on breakdown will be discussed. Another important source of klystron failure in the recent past at SLAC has been the puncturing of the high voltage ceramic insulator in the gun region. A way of alleviating this problem has been found although the actual cause of the puncturing is not yet clear. The "practical" solution to this breakdown process will be described and a possible mechanism for the puncturing will be presented. 9 refs., 5 figs., 3 tabs.

4304 Storage Rings

REFER ALSO TO CITATION(S) 30932

30948 **99.99% Al/6063 alloy coextruded cryogenic beam tube.** Ishimaru, H.; Narushima, K.; Kanazawa, K.; Suetsugu, Y.; Bintinger, D.; Joestlein, H.; Trobojevic, D. (National Laboratory for High Energy Physics, Oho-machi, Tsukuba-gun, Ibaraki-ken, 305, Japan). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1293-1296(May 1988).

A beam tube composed of 6063 alloy aluminum with a coextruded inner surface of 99.99% pure aluminum is proposed for the Superconducting Super Collider (SSC). It has higher electric conductivity than oxygen-free pure copper at liquid-helium temperature. Thermal desorption rate is $\sim 10^{-12}$ Pa l/s cm^2 after 150 °C 24-h baking. Dynamic gas desorption by synchrotron radiation from the inner surface at liquid-helium temperature was measured with and without magnetic field. Magnetic field reduces the pressure rise by synchrotron radiation by one order of magnitude at liquid-helium temperature. If a pure Al clad beam tube is accepted for SSC vacuum system, vacuum components of aluminum alloy which can be operated at liquid-helium temperature are needed. Dynamic bellows, nonmagnetic feedthroughs, an all metal gate valve, a compact turbomolecular pump, an automatic welding machine, and a new type of pressure monitor along the ring have been developed.

44 INSTRUMENTATION

30949 **(USIP—86-09) High speed, selective multi-ADC to computer data transfer interface, for nuclear physics experiments.** Arctaedius, T.; Ekstroem, R.E. (Stockholm Univ. (Sweden). Inst. of Physics). Aug 1986. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753036/JAW.

A link connecting up to fifteen Analog to Digital Converters with a computer, through a Direct Memory Access interface, is described. The interface decides which of the connected ADC:s that participate in an event, and transfers the output-data from these to the computer, accompanied with a 2-byte word identifying the participating ADC:s. This data format can be recorded on tape without further transformations, and is easy to unfold at the off-line analysis. Data transfer is accomplished in less than a few microseconds, which is made possible by the use of high speed TTL circuits. (authors).

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 30453, 31008, 31197

30950 **(AD-A—189026/8/XAB) Response characteristics of dual MOSFET gamma-ray sensors produced by Mitel Corporation.** McGowan, S.; Gravelle, R.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Sep 1987. 29p. (DREO—971). NTIS, PC A03/MF A01.

Abstract in French.

Radiation-sensitivity measurements were carried out on two batches of dual MOSFET gamma-radiation sensors produced by Mitel Corp and packaged using different procedures by two other commercial firms. Significant differences were observed between the two production batches and also as a result of the difference in packaging. Those from the first Mitel batch packaged by Siltronics Limited were found to be most consistent and should be acceptable as sensor for the Canadian Forces individual dosimeter. Nonuniformities in response with photon energy can be attributed to the large amounts of gold in the packages used, and measurements indicate that elimination of the gold will lead to good energy response. A reduced response at very high dose rate is alleviated by the addition of capacitance to maintain gate bias during the radiation pulse, but further testing will be required to evaluate the dosimeter performance under relevent field conditions.

30951 **(AD-A—189078/9/XAB) Comparison of AFRRI (Armed Forces Radiobiology Research Institute) and ETCA (Etablissement Technique Central de l'Armament) dosimetry measurements at AFRRI TRIGA (Training Research Isotopes General Atomic) reactor. Technical report.** Dooley, M.; Zeman, G.H. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Nov 1987. 13p. (AFRRI-TR—87-1). NTIS, PC A03/MF A01.

A series of irradiations was performed at the AFRRI TRIGA reactor as the initial step in establishing a dosimetric link between neutron radiobiology research (using high dose rates close to the source) and military applications experiments (using low dose rates farther from the source). A team of physicists from ETCA, part of the French Ministry of Defense, irradiated several personnel dosimeters both free in air (FIA) and at various depths in an anthropomorphic dosimetry phantom. As reference dosimetry, the ETCA group used fission chambers and AFRRI dosimetrists used paired ionization chambers. The kerma rates measured FIA by the two groups with fundamentally different methods showed excellent agreement (within 5%). However, more work is required to resolve some of the difference observed in the in-phantom measurements. The completion of these experiments marks an important first step in relating mixed-field radiobiology studies to potential combat radiation environments.

30952 **(AD-A—189125/8/XAB) Thermoluminescence response of CaF2:Mn, CaF2:Dy and $CaSO_4$:Tm to protons and alpha particles.** McGowan, S.; Gravelle, R.A. (Defence Research Establishment, Ottawa, Ontario (Canada)). Apr 1987. 20p. (DREO—959). NTIS, PC A03/MF A01.

Abstract in French.

Proton/gamma and alpha/gamma response ratios were measured for very fine powders of the thermoluminescent phosphors CaF2:Mn, CaF2:Dy and CaSO4:Tm. This was done as part of an evaluation of these phosphors for use in a combined neutron/gamma thermoluminescent dosimeter which is made neutron-sensitive by embedding the phosphor powder in an hydrogenous medium. The CaF2:Mn phosphor was found to be marginally better than the other two for this purpose. Reduction in the measured proton/gamma response ratio with decreasing proton energy was attributed primarily to relatively low response near the surfaces of the phosphor particles.

30953 **(AD-A—189816/2/XAB) Evaluation of a high-pressure proportional counter for the detection of radioactive noble gases. Master's thesis.** Lackey, R.E. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Jan 1987. 133p. NTIS, PC A07/MF A01.

This report presents a study of the characteristics of a high-pressure proportional detector for the qualitative and quantitative analysis of radioactive noble gases. Several external sources (Americium 241, Cadmium 109 and Cobalt 57) were used to establish the detector's response at high pressures using argon fill gas. A radioactive xenon gas sample with Xenon 131m and Xenon 133 was used to demonstrate the detector's utility for the analysis of radioactive noble gases. Procedurally, counting gas from a 12.34-liter reservoir was cryo-genically condensed in the 0.197-liter detector volume. Energy calibration was performed using the external sources. The analysis of the internal radioactive xenon gas source was not suc-

cessful. The Xenon 131M to Xenon 133 concentration was 50% of the planned minimum value, and the Xenon 133 source activity was one hundred times the acceptable level. The associated detector recovery time and space-charge density reduced the efficiency drastically (approx 1%). Occasional unpredictable responses from contaminants adsorbed in the epoxy seals produced excessive numbers of erratic data with the internal noble-gas source.

30954 **(BNL—40717) Report of the intermediate-{ital p}/ sub perpendicular/ detector group: A beauty spectrometer for the SSC [superconducting super collider].** Foley, K.J.; Buchanan, C.D.; Morrison, R.J.; McHugh, S.W.; Witherell, M.S.; Atac, M.; Cox, B.; Purohit, M.V.; Stefanski, R.; Wagoner, D.E. (Brookhaven National Lab., Upton, NY (USA); California Univ., Los Angeles (USA); California Univ., Santa Barbara (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Heidelberg Univ. (Germany, F.R.); Northeastern Univ., Boston, MA (USA)). Jul 1987. Contract AC02-76CH00016. 29p. (CONF-870739—17; UCSB-HEP—87-15).

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

A "Beauty Spectrometer" has been designed for studies of B physics at the SSC. The ultimate goal is a definitive measurement of CP violation in the B system. The spectrometer consists of two stages and occupies one side of an intermediate-luminosity interaction region. An upstream, or intermediate, stage extends from the interaction point to 14 m and covers the angular region from 57 mrad (3.3 degree) to 350 mrad (20 degree). The forward stage extends to 77 m and to angles down to 5.7 mrad. The design includes silicon microstrip detectors, conventional tracking, momentum analysis, and hadron and lepton identification. While no fundamental problems have been found, the detector must deal with unprecedented particles fluxes, trigger rates, and data rates. 11 refs., 10 figs., 5 tabs.

30955 **(BNL—40873) Calorimetry for a 4π-RHIC detector.** Poskanzer, A.; Gordon, H.; Lissauer, D.; Ludlam, T.; Olsen, L.; Akesson, T.; Fabjan, C.W.; Schukraft, J.; Sonderegger, P.; Wigmans, R. (California Univ., Berkeley (USA); Brookhaven National Lab., Upton, NY (USA); European Organization for Nuclear Research, Geneva (Switzerland); Columbia Univ., Irvington-on-Hudson, NY (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Heidelberg Univ. (Germany, F.R.)). 7 Dec 1987. Contract AC02-76CH00016;W-7405-ENG-36. 27p. (CONF-870543—8; CERN-EP—87-221). NTIS, PC A03/ MF A01; 1; GPO Dep. Order Number DE88007016/JAW.

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

Two working groups, one centered at BNL and the other at CERN, have been studying RHIC-specific calorimetry issues relevant to a large 4π-general purpose RHIC detector. Topics covered included the required energy and position resolution, low energy response and calorimeter associated background, as well as instrumentation of the detectors. These considerations led to a conceptual design, which was further developed during the Workshop. 19 refs., 11 figs.

30956 **(BNL—40874) First tests with fully depleted PN-CCD's.** Strueder, L.;Lutz, G.;Sterzik, M.;Holl, P.;Kemmer, J.;Prechtel, U.;Ziemann, T.;Rehak, P. (Brookhaven National Lab., Upton, NY (USA); Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). 1987. Contract AC02-76CH00016. 5p. (CONF-871006—50). NTIS, PC A; 02; GPO Dep. Order Number DE88007573/JAW.

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

We have fabricated 280 μm thick fully depletable pn CCD's on high resistivity silicon ({rho} ~ 2.5 kΩcm). Its operation is based on the semiconductor drift chamber principle proposed by Gatti and Rheak. They are designed as energy and position sensitive radiation detector for (minimum) ionizing particles and X-ray imaging. Two dimensional semiconductor device modeling demonstrates the basic charge transer mechanisms. Prototypes of the detectors have been tested in static and dynamic conditions. A preliminary charge transfer inefficiency was determined to 6 x 10{sup{minus}3}. The charge loss during the transfer is discussed and as a consequence we have developed an improved design for a second fabrication iteration which is now being produced. 4 refs., 15 figs.

30957 **(BONN-IR—87-41) Studies on the application of transition radiation for the particle identification at ZEUS.** Oedingen, R. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Nov 1987. 99p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753535/JAW.

The electron-proton storage ring HERA at DESY will probe new kinematical regions of deep inelastic electron-nucleon scattering. In particular, new heavy particles may be produced with masses up to 180 GeV. The ZEUS collaboration is presently going to develop a suitable detector for the expected physical interactions at HERA. One of the most important requirements for ZEUS is a good performance of the electron identification system. A Transition Radiation Detector (TRD) is being developed to meet this task by separating hadrons and electrons. This thesis describes studies to find an optimum layout for the TRD to be used in ZEUS. Two series of measurements were performed at CERN and DESY in the momentum range between 1 GeV/c and 6 GeV/c in order to separate electrons from pions. Foams as well as fibres and foils served as radiator materials to create TR photons while two types of chambers, a longitudinal drift chamber (DC) and a multiwire proportional chamber (MWPC), were used for detecting the TR quanta within a setup consisting of four complete modules. Both kinds of chambers had a depth of 16 mm and were dominantly filled with xenon. Analyzing the total charge data, methods of mean, truncated mean and maximum likelihood algorithms have been applied. Several procedures were tested to analyze the signal structure in detail - a so called cluster analysis. As a result of the total charge measurements a pion contamination of about 1% is obtained at 90% electron detection efficiency with a polypropylene radiator in a configuration of four modules of a total length of 40 cm. An improvement by a factor of about two for the discrimination of pions can be obtained in case of a detailed cluster analysis. (orig./HSI).

30958 **(BRP/HEP—87-1) Charged particle tracking in the ZEUS experiment at HERA.** Foster, B. (Bristol Univ. (UK). H.H. Wills Physics Lab.). 1987. 21p. (CONF-8705241—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753090/JAW.

From 10. WARSAW symposium on elementary particle physics; Kazimierz, Poland (25 May 1987).

The main features of the ZEUS detector at HERA are described, with particular reference to the inner charged particle tracking detectors. Progress on prototyping and testing of these components is outlined. The design of the electronics and triggering for the tracking detectors is discussed in some detail.

30959 **(CERN-EP—86-157) Test of a data-driven trigger processor for experiment UA8.** Zweizig, J.G.; Cheze, J.B.; Ellett, J.; Erhan, S.; Jackson, R.; Medinnis, M.; Schlein, P.E.; Zsembery, J. (California Univ., Los Angeles (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 10 Oct 1986. 14p. (CONF-8606240—5).

From 3. Pisa meeting on advanced detectors; Pescaia, Italy (2 Jun 1986).

A fast trigger, based on principles of data-driven processing, has been designed and tested for CERN SPS-Collider experiment UA8. The electronics calculates the momentum vector of a track traversing the UA8 Roman pot spectrometer in 500 ns. When imbedded in the chamber TDC readout system, the total time between signal arrival in the counting room and result is 1.2 μs. The calculations are performed by successive table look-ups and arithmetic operations executed by several examples of a single type of module configured in a data-driven architecture. The operation of the system is monitored with a package of control and diagnostic software. The trigger processor has been successfully tested at the SPS-Collider. 10 refs., 7 figs.

30960 (CERN-EP—86-183) Preliminary analysis of the performance of a rich counter for low-p/sub T/ electron identification at the CERN p anti p Collider. Botner, O.; Eek, L.O.; Ekeloef, T.; Fransson, K.; Hallgren, A.; Kostarakis, P.; Lenzen, G.; Lund-Jensen, B. (European Organization for Nuclear Research, Geneva (Switzerland); Uppsala Univ. (Sweden). Gustaf Werner Inst.). 13 Nov 1986. 14p. (CONF-8605164—6).

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

A ring-imaging Cherenkov (RICH) counter with a 60 cm long freon (C_2F_6) gas radiator has been used inside the UA2 detector at the CERN SPS p anti p Collider, the aim being to measure the amount of promptly produced electrons in the p/sub T/ region 1 to 3 GeVc. About 800,000 events were recorded and the analysis is in progress. Results from a first analysis of a limited event-sample indicate that it will be possible to reach an $e\pi$ rejection power of at least 10^{-4} with the RICH counter. 3 refs., 8 figs.

30961 (CERN-EP—86-203) Calorimetry in particle physics. Barbiellini, G. (European Organization for Nuclear Research, Geneva (Switzerland)). 28 Nov 1986. 38p. (CONF-8603236—1).

From 14. international winter meeting on fundamental physics; Catalonia, Spain (17 Mar 1986).

This paper on calorimetry in particle physics is divided into four parts: the basic principles and intrinsic limitations of calorimetric energy measurements; operation mode and features of the two main categories of calorimeters: homogeneous calorimeters and sampling calorimeters; a review of the best known (at least to the author) calorimeters operating in different domains of particle physics: calorimeters in neutrino physics; fast calorimeters for beam-dump experiments; calorimeters for collider experiments (p{ovr p}, e^-e^+); calorimetry at future colliders; and calorimeters for underground experiments; and open problems (at the time of the School) concerning hadron calorimeter compensation phenomena; and recent data on depleted uranium (DU) calorimeters. 34 figs., 6 tabs.

30962 (CERN-EP—87-60) Today and tomorrow for scintillating fibre (SCIFI) detectors. Kirkby, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 23 Mar 1987. 73p. (CONF-8609283—4).

From Workshop on vertex detectors: state of the art and perspectives; Erice, Italy (21 Sep 1986).

We review the current status of SCIFI detectors in experimental particle physics and their prospects in tomorrow's supercollider detectors. Our main focus concerns tracking devices, although we also discuss the important aspects of SCIFI calorimetry. We could say, in summary, that SCIFI detectors will have a bright future. 54 refs., 52 figs.

30963 (CONF-880244—1) Calorimetry applied to nucleus-nucleus collisions at ultrarelativistic energies. Plasil, F. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 45p. NTIS, PC A; 03; GPO Dep. Order Number DE88006173/JAW.

From Miniworkshop on experimental techniques in relativistic heavy-ion experiments; Bombay, India (13 Feb 1988).

A general introduction to high-energy calorimetry is presented, together with brief descriptions of the two types of cascades relevant to calorimetric measurements. This is followed by a discussion of "compensation" and of the "e/h" ratio. A detailed description of two calorimeters designed and constructed for the CERN WA80 experiment are also given. 16 refs., 17 figs., 5 tabs.

30964 (IFVE-OEF—87-130) Measurement of the resolution of combined hodoscope calorimeter at 18 and 38 GeV. Alde, D.; Binon, F.; Brikman, K. and others. (Los Alamos National Lab., NM (USA); Institut Interuniversitaire des Sciences Nucleaires, Brussels (Belgium)). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702748/JAW.

The energy and space resolution of a combined cellular detector involving the Cherenkov photon calorimeter GAMS-2000 and the modular hadron calorimeter GDA-100 has been studied at 18.5 and 38 GeV incident hadron energies at the IHEP accelerator. The energy resolution of the combined detector is substantially improved by applying correction based on the analysis of the lateral development of hadron showers in GAMS and GDA. It is shown that the parameters of the correction depend only weakly on the hadron energy. With the energy increased the influence of the gap between both photon and hadron calorimeters on the combined detector characteristics is of less importance. 11 refs.; 10 figs.; 1 tab.

30965 (INFN/AE—86-5) Space resolution of the TPC [Time Projection Chamber]. Rolandi, L. (Trieste Univ. (Italy). Dipartimento di Fisica). 2 Apr 1986. 26p. (CONF-8603236—2). NTIS (US Sales Only), PC A03/MF A01;1. Order Number DE88900406/JAW.

From 14. international winter meeting on fundamental physics; Catalonia, Spain (17 Mar 1986).

The principle of coordinate measurement of the Time Projection Chamber is discussed together with the various factors that influence the measuring accuracy in the sagitta direction. Some experimental results on the spatial resolution with different cathode geometry are presented and are compared with the theory. 9 refs., 13 figs.

30966 (INIS-BR—1068) Design, construction and testing of a self-powered neutron detector. Correa, R.F. (Minas Gerais Univ., Belo Horizonte (Brazil). Curso de Pos-graduacao em Ciencias e Tecnicas Nucleares). 1987. 111p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702766/JAW.

The design, construction and testing of a self-powered neutron detector (SPN) and associated electronics are described. Several tests were performed giving information about dielectrical properties of detector and cable, gamma spectra induced in the detector through reactor irradiation, detector response as a function of neutron flux, current stability and reproductibility with the neutron flux. The gamma and neutron sensitivities were also evaluated, by means of thermoluminescent dosimeters and gold foils as references. The test results are presented and show that the detector response is reliable. The gamma and neutron sensitivities are in agreement with those found in the available literature. Nevertheless, a ceramic insulated cable should be employed for permanent use in a reactor. The tests were performed in a 100 KW TRIGA Mark I reactor at the Centro de Desenvolvimento da Tecnologia Nuclear of NUCLEBRAS, in Belo Horizonte, Brazil.

30967 (INIS-mf—11716) Measurements of electron drift and diffusion properties in a large cylindrical drift chamber (TPC) with parallel electric and magnetic fields. Richstein, J. (Dortmund Univ. (Germany, F.R.). Fachbereich Physik). 18 Dec 1986. 85p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753552/JAW.

This work describes measurements on the drift of electrons in gases, using the TPC90, the prototype of the ALEPH Time Projection Chamber. Tracks which were created by UV-Laser ionization have been drifted over distances of up to 1.3 m in parallel electric and magnetic fields. Electron drift properties have been systematically measured as a function of these, in several gas mixtures. (orig./HSI).

30968 (LA—11096-MS) Safeguarding LWR [light-water reactor] spent fuel with the fork detector. Rinard, P.M.; Bosler, G.E. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 82p. (ISPO—281).

The fork detector measures passive neutron and gamma-ray emissions from irradiated fuel assemblies for safeguards purposes. The detector is transportable, takes data rapidly, and requires only partial removal of the assemblies from the storage racks. After describing the detector and the nature of the data taken with it, this report will concentrate on the sensitivity of the detector to missing fuel pins. The interactions between the analyses of the neutron and gamma-ray data place severe restrictions on potential diverters. The fork detector essentially forces a potential diverter into either foregoing a diversion or making a large diversion that could be readily detected. A diversion that would escape detection by the fork

would require the removal of a few pins from a large number of assemblies, enhancing the detection probability by other safeguards techniques. 38 refs., 34 figs., 8 tabs.

30969 **(LBL—24604) Proceedings of the Second Workshop on Experiments and Detectors for a Relativistic Heavy Ion Collider (RHIC).** Ritter, H.G.; Shor, A. (eds.). (Lawrence Berkeley Lab., CA (USA); Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC03-76SF00098. 346p. (CONF-870543—).

From 2. workshop on experiments and detectors for relativistic heavy ion collider; Berkeley, CA, USA (25 May 1987).

Separate abstracts were prepared for 24 papers in these proceedings. (LEW)

30970 **(N—88-20247) Joint NASA/Goddard-University of Maryland research program in charged particle and high energy photon detector technology. Semiannual progress report, April-September 1987.** (Maryland Univ., College Park (USA)). Apr 1988. 13p. (NASA-CR—182612; NAS—1.26:182612). NTIS, PC A03/MF A01.

Having recognized at an early stage the critical importance of maintaining detector capabilities which utilize state of the art techniques, a joint program was formulated. This program has involved coordination of a broad range of efforts and activities including joint experiments, collaboration in theoretical studies, instrument design, calibrations, and data analysis. Summaries of the progress made to date are presented. A representative bibliography is also included.

30971 **(N—88-20251) Imaging of extra-galactic low-energy gamma-ray sources prospects, techniques, and instrumentation. Ph.D. Thesis.** Finger, M.H. (California Inst. of Tech., Pasadena (USA)). Aug 1987. 239p. (NASA-CR—182536; NAS—1.26:182536; SRL—87-21). NTIS, PC A11/MF A01.

Improved understanding of the nature of active galaxies will require detailed observations of 10 to 20 sources, while understanding of their gamma ray luminosity function and its evolution will require the detection of approximately 100 sources. Instruments capable of detecting 100 active galaxies at low, gamma energies are achievable. The angular resolution of an instrument, as well as its sensitivity, can limit the number of sources it can observe. An investigation of the angular resolution requirements for future low-energy gamma ray instruments is presented. It was found that the strictest requirements arise not from the need to resolve detectable sources, but from the need to control the level of direction-to-direction fluctuations in the diffuse background level. It was concluded that gamma-ray instruments capable of detecting 100 active galaxies must have sub-degree angular resolution. The use of the coded aperture imaging technique is proposed as a method of achieving accurate control of systematic errors and fine angular resolution without unduly increasing the time needed to conduct full sky surveys. An analysis of coded aperture imaging is presented for instruments that employ masks based on hexagonal uniformly redundant arrays. An instrument, the gamma-ray imaging payload, was built that employs these imaging techniques. The design and testing of the instrument is described in detail. Preliminary results from a balloon flight of the instruments are shown, demonstrating its imaging performance.

30972 **(NAC—85-10) Pulse selector for neutron time-of-flight measurements.** De Kock, P.R.; Botha, A.H.; Cronje, P.M. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1986. 58p. (In Afrikaans). CSIR, National Accelerator Centre, P O Box 72, Faure, 7131, South Africa.

The energy spectrum of neutrons excited by high-energy particles in a nuclear reaction is usually determined by the time-of-flight method. Since a time spectrum is registered, charged particles are supplied as pulses with a repetition time tau/sub S/. The particulated pulses of the OSS however, possess a very short repetition time. A longer repetition time may be obtained by means of a pulse selector system. This report deals with such a pulse selector system.

30973 **(NIKHEF-H—87-12) Energy loss of particles in dense matter - calorimetry. Lecture notes.** Wigmans, R. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Aug 1987. 111p. (CONF-8706296—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702471/JAW.

From ICFA school on instrumentation in elementary particle physics; Trieste, Italy (8 Jun 1987).

In the last decade, a class of detectors gradually have become more and more important in experimental particle physics. They are called calorimeters, or total absorption detectors. Basically a calorimeter is a block of matter, in which the particle to be measured interacts, and deposits all its energy in the form of a shower of decreasingly lower-energy particles. The block is made such that certain (usually small and hopefully constant) fraction of the initial particle energy is transformed in a measurable signal (light, electrical charge). This lecture mainly deals with sampling calorimeters but in section 2 also fully sensitive devices are briefly treated. In this section calorimeters for detecting electromagnetic showers are discussed. The physics processes relevant to em shower development are examined, and the factors that limit the performance of em calorimeters. Section 3 is devoted to readout techniques for sampling calorimeters. In sections 4-7 hadron calorimeters are discussed. The physics processes relevant to hadron shower development, their consequences for the calorimeter signals and the possibility for optimizing the performance of hadron calorimeters are examined. In section 8 an outlook for future development is given. 31 refs.; 48 figs.

30974 **(NUCLEBRAS-CDTN—543) Construction of a self-powered neutron detector prototype.** Pombo, J.B.S.M.; Correa, R.F. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1986. 8p. (In Portuguese). (CONF-860343—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701699/JAW.

From 1. general congress on nuclear energy; Rio de Janeiro, Brazil (17 Mar 1986).

Description and testing of a self-powered neutron detector and related current measurement electronics, in construction at Centro de Desenvolviemnto da Tecnologia Nuclear (CDTN), are presented. The cylindrical detector has a 9-wires cobalt emitter, Inconel 600 tubing collector and sinterized alumina electrical insulation. The bifilar signal cable is plugged to the detector through a SHV connector. Preliminary testing has giving information about dielectrical properties of the set and impurities of the materials (by means of activation analysis). The main tests, done in a 100 KW Triga Reactor, allowed the verification of the detector response to the neutron flux, the stability and reproducibility of this response, and also the evaluation of sensitivity to gamma radiation. The detector performance is considered good.

30975 **(ORNL—6462) SCINFUL: A Monte Carlo based computer program to determine a scintillator full energy response to neutron detection for E/sub n/ between 0.1 and 80 MeV: User's manual and FORTRAN program listing.** Dickens, J.K. (Oak Ridge National Lab., TN (USA)). Mar 1988. 222p.

This document provides a complete listing of the FORTRAN progran SCINFUL, a program designed to provide a calculated full response anticipated for either an NE-213 (liquid) scintillator or an NE-110 (solid) scintillator. The incident design neutron energy range is 0.1 to 80 MeV. Preparation of input to the program is discussed as are important features of the output. Also included is a FORTRAN listing of a subsidiary program applicable to the output of SCINFUL. This user-interactive program is named SCINSPEC from which the output of SCINFUL may be reformatted into a standard spectrum form involving either equal light-unit or equal protran-energy intervals. Examples of input to this program and corresponding output are given.

30976 **(PNL-SA—14735) Evaluation of the instrument correction factors needed in beta dosimetry.** Swinth, K.L.; Sisk, D.R.; Selby, J.M.; Vallario, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 11p. (CONF-880404—17).

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

Generally, the same survey instruments used for the measurement of gamma dose rates are used for monitoring beta fields by making measurements with and without a shield over the detector to separate the penetrating and nonpenetrating components of the radiation field. Survey meters are calibrated using fields that uniformly irradiate the detector volume with the center of the volume used as a reference point. However, under field survey conditions, sources are frequently encountered that have irregular shape and large or small dimensions compared with the detector volume. When the distance from the source to the detector volume (reference point) is small such sources produce non-uniform radiation fields in the detector. Similarly, low energy beta sources cause nonuniform irradiation of the volume due to attenuation of the radiation. In addition, when survey meters are used close to the source, the surveyor is generally interested in dose rates at contact or within a few centimeters of the source. In these cases the reference point is the center front surface of the detector. The resulting readings from such fields are based on an average of the uneven distribution of energy deposition occurring within the detector. In general, this reading would be significantly less than the actual dose existing at the surface of the meter entrance window. To compensate for this discrepancy, correction factors are applied to the readings to give the actual dose. These factors can be in excess of a factor of 100. This paper summarizes observations on energy, angular and source geometry response of survey instruments.

30977 **(PNL-SA—14754) Comparison of neutron track detector sensitivity as a function of the etching process.** Parkhurst, M.A.; Hadlock, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 5p. (CONF-880404—9).

From 7. international congress of the International Radiation Protection Association; Sydney, Australia (10 Apr 1988).

This report describes electrochemical etching and interpretation of allyl diglycol carbonate (ADC) neutron track detectors for use in personnel dosemeters. 4 figs., 1 tab.

30978 **(PNL-SA—15638) Progress in ultralow background Ge detector searches for the $\beta\beta$-decay of ^{76}Ge, dark matter candidates, and solar axions.** Avignone, F.T. III;Brodzinski, R.L.;Miley, H.S.;Reeves, J.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 23p. (CONF-8710298—1). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006669/JAW.

From Conference on weak interaction physics; Heidelberg, F.R. Germany (1 Oct 1987).

Recent results from a number of ^{76}Ge {beta beta}-decay experiments and the different approaches in nuclear structure calculations which impact their interpretation are discussed. An update of current efforts to improve the sensitivities of these experiments is given. A brief review of the recent publications on searches for dark matter candidates and solar axions is also given. 4 refs., 15 figs.

30979 **(RAL—87-113) Development of the ZEUS detector.** (Rutherford Appleton Lab., Chilton (UK)). Dec 1987. 33p. (CONF-8710308—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753098/JAW.

From DESY theory workshop; Hamburg, F.R. Germany (12 Oct 1987).

ZEUS is a detector for esup(+-)p collisions at HERA. It is designed with the best possible hadronic energy resolution in mind. A depleted-uranium calorimeter provides a resolution of 0.35 Esup(-12) + .02 and hermetic coverage. Charged particles are tracked to resolution σsub(p)p = 0.002p + 0.003 (90°) and < 0.01p for angles above 140 mrad. A vertex detector measures impact parameters to 50 μm accuracy. Forward and barrel muon systems measure and identify muons with a hadron rejection of 10^{-3}. Silicon calorimeter pads and transition radiation detectors provide excellent electron identification. The luminosity monitor also tags photons at $Q^2 = O$, and leading protons are detected over a wide momentum range.

30980 **(SAND—88-0089C) X-ray response of GaAlAs/GaAs radiation hardened double: Heterostructure photodiode compared to Si:PIN photodiodes.** Anthes, J.P. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880364—7). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007425/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Requirements fro continuous operation of photodiodes in the presence of nuclear radiation has led to the development of a novel GaA1As/GaAs photodiode. Device structure and semi conductor properties of this design were optimized to balance the need for photodetection at λ {equals} 820 nm against unwanted excess photocurrents induced by ionizing radiation. To achieve radiation hardness the photodiode employs a double heterojunction device structure. The spectral response of this detector, 1 keV to 10 MeV, may offer unique opportunities for use in high-temperature plasma diagnostics compared to typical bare Si:PIN x-ray photodiode characteristics. Application of this GaA1As/GaAs detector in a fiber optic link will be reviewed. Also, use of this detector in simple atomic-absorption-edge filtered x-ray detector channels is presented. 12 refs., 5 figs.

30981 **(USIP—86-10) Monte Carlo-simulated response of multi-material scintillation detectors to high energy gamma radiation.** Ritzen, B.; Bargholtz, C.; Liljequist, D.; Ismail, M. (Stockholm Univ. (Sweden). Inst. of Physics). Sep 1986. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753037/JAW.

This report describes a computer code, DETECSIM, developed as a first step in a detector design project. The code is applicable in the gamma-ray energy range 100 keV - 100 MeV and is intended as a tool in the investigation of the properties of detectors consisting of two or more scintillating materials combined in a variable geometry. We have studied the case of BGO/BaF/sub2/ crystals. The reliability of the code has been tested against previous experimental and simulated results for mono-material crystals.(authors).

30982 **Radiative corrections to the solar-neutrino counting rate in the gallium detector.** Dicus, D.A.; Wilson, S.L. (Center for Particle Theory, University of Texas at Austin, Austin, Texas 78712). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 10, 3056-3058(15 May 1988).

We calculate radiative corrections to the flux from various solar-neutrino processes and to the counting rate of neutrinos in the gallium solar detector.

30983 **Errors associated with the measurement of scattered polarized X-rays.** Hanson, A.L.; Meron, M. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research;* **264**: No. 2/3, 488-496(15 Feb 1988). Contract AC02-76CH00016.

In two previous papers methods of calculating the cross sections integrated over solid angle for the coherent and incoherent scattering of polarized X-rays by atoms into an arbitrarily placed circular aperture were presented. The errors associated with the measurement of scattered X-rays for quantitative analyses are discussed in the present paper.

30984 **Large-area fast-timing detectors developed for the TOFI spectrometer.** Kraus, R.H. Jr.; Vieira, D.J.; Wouters, J.M.; Wollnik, H. (Clark Univ., Worcester, MA (USA); Los Alamos National Lab., NM (USA); Giessen Univ. (Germany, F.R.)). *Nuclear Instruments and Methods in Physics Research;* **264**: No. 2/3, 327-332(15 Feb 1988).

Large-area fast-timing detectors have been developed for use in the TOFI spectrometer. A gridless detector was constructed in which secondary electrons emitted from a thin ($\approx$ 80 μgcm^2) target foil were transported isochronously to microchannel plate electron multipliers by crossed electric and magnetic fields. A novel convex anode was designed to reduce the time dispersion caused by the position at which the secondary electrons were collected. Timing performance for aluminium oxide target foils was found to be superior to that of carbon foils. Intrinsic timing resolutions of 68 and 109 ps

fwhm have been measured for 5.4 MeV alpha particles from a thin ^{241}Am source for two different detectors with active areas of 270 and 1000 mm^2, respectively. Detection efficiencies in excess of 75% for alpha particles were measured.

30985 **Sonar-based technique for the ratiometric determination of binary gas mixtures.** Hallewell, G.; Crawford, G.; McShurley, D.; Oxoby, G.; Reif, R. (Stanford Linear Accelerator Center, CA (USA)). *Nuclear Instruments and Methods in Physics Research;* **264**: No. 2/3, 219-234(15 Feb 1988). Contract AC03-76SF00515.

We have developed an inexpensive sonar-based instrument to provide a routine on-line monitor of the composition and stability of several gas mixtures having application in a Cherenkov Ring Imaging Detector. The instrument is capable of detecting small (<1%) fluctuations in the relative concentration of the constituent gases and, in contrast with some other gas analysis techniques, lends itself well to complete automation.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 30606, 30729, 30847, 30895, 31203, 31621, 31950

30986 **(BHR—39) Reactor physics model for a pulsed-neutron capture-gamma borehole logging tool.** Oelgaard, P.L. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). Mar 1987. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753006/JAW.

A reactor physics model for a pulsed-neutron capture-gamma borehole logging tool is described. It is based on Fermi-age theory for the fast neutrons and the time-dependent diffusion equation for the thermal neutrons. The calculation of the gamma flux is performed by use of the build-up factor concept. A number of examples of numerical calculations with the model is presented and discussed. Finally a practical application of the pulsed-neutron, capture-gamma logging tool is briefly outlined.

30987 **(IC—87/340) Distortions in processed signals and their application in electronic design - I: Basic and general formulations.** Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702731/JAW.

Complete analytical expressions for the distortion signals introduced into analogue signals by sampling and quantization processes are developed. These expressions are made up of terms that are wholely functions of the parameters of the original signals involved and hence are easy to evaluate numerically. It is shown in Parts 2 and 3 of this series that these expressions may be successfully used in the design and development of some electronic devices whose operation depends upon the above-named distortion signals. (author). 7 refs.

30988 **(IC—87/341) Distortions in processed signals and their application in electronic design - II: A new variable signal generator.** Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702732/JAW.

We describe the main design and operational features of a new type of variable audiofrequency signal generator. Unlike the conventional signal generators, this generator operates principally on the basis of distortions introduced into two oscillator-generated sinusoidal signals by a double sampling process. Successful testing of the new signal generator is also reported. (author). 4 refs, 3 figs.

30989 **(IC—87/342) Distortions in processed signals and their application in electronic design - III: An automated generator of communication jamming signals.** Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702733/JAW.

We describe the design and operational features of a simple electronic circuit that is capable of automatically generating a narrow bandwidth jamming signal around each frequency signal received from target transmitters. It is noted that jamming based upon this circuit is fairly difficult to nullify using some of the conventional "counter jamming" strategies since in this case the jamming signals are flexibly locked onto the spectral components of the received signals. (author). 3 refs, 3 figs.

30990 **(ORNL/TM—10751) Evaluation of the ion trap mass spectrometer for potential application in the space station.** Glish, G.L.; McLuckey, S.A. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 166p.

This report describes preliminary experiments with an ion trap mass spectrometer, which were done to evaluate its potential for use in the environmental monitoring system of the proposed space station. The first section of the report describes various modes of operation of the instrument, discusses some of the present limitations, and discusses some of the potential solutions to these limitations. The next section discusses the experimental results obtained on sixteen compounds with particular emphasis on comparing these data to that expected from a standard mass spectrometer. The last section consists of a conclusion and comments on suggested future work. 16 figs.

30991 **(PB—88-863006/XAB) Chemical and biological warfare: detection and warning systems. June 1984-April 1988 (Citations from the NTIS data base). Report for June 1984-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 61p. NTIS PC N01/MF N01.

Supersedes PB—87-857637.

This bibliography contains citations concerning the design and testing of samplers and detectors to provide identification and warning of the presence of chemical and biological agents used in military operations. The sampling techniques are applicable to air and water testing, and to evaluate personnel and equipment exposure. Techniques involve enzyme alarms, chromotography, conductivity meters, spectrophotometry, luminescence, and solid state microsensor devices. Other published searches in this series on chemical warfare cover protection, defoliants, general studies, and biological studies, including chemistry and toxicology. (This updated bibliography contains 99 citations, 18 of which are new entries to the previous edition.)

30992 **(SAND—86-1398) SANDUS [Sandia Digital Underground System] (MA 164) command system message and data format.** Ebinger, L.W. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 58p.

The SANDUS (Sandia Digital Underground System - MA164 Digital Data Acquisition System) is controlled by either an internal or external minicomputer via the TA485A Controller. This controller is used to set up the TA484A Multiplexer, TA618 Real Time Multiplexer, TA489A Calibrator, TA486A Programmer Timer, TA566A Power Controller/Encoder and TA488B Trigger Generator. It also sets the voltage gain and offset, presample filter frequency response, data sample interval, data conversion format (9 bit, 12 bit or extended range), arm signal, trigger mode and number of presamples, etc. for each of the 128 data channels. The format and function of the command system messages and their data formats are detailed herein.

30993 **(SAND—87-1948C) Change detection for target detection and classification in video sequences.** Donohoe, G.W.;Hush, D.R.;Ahmed, N. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880421—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007583/JAW.

From IEEE international conference on acoustics, speech and signal processing; New York, NY, USA (11 Apr 1988).

This paper describes a family of adaptive change detectors for detecting and segmenting moving objects in video scenes. These change detectors employ several techniques to allow them to adjust to changing image conditions. One of these is a dynamic reference frame which allows the system to adapt to changing backgrounds

and produces an unambiguous target silhouette for classification. Another is a scheme to estimate system noise and adjust detection thresholds accordingly to satisfy a chosen performance criterion. Finnaly, adaptive normalization is used to maintain constant image contrast. 6 refs., 5 figs.

30994 **(SAND—87-3035C) Photoconducting x-ray detectors for Z-pinch experiments.** Spielman, R.B.;Hsing, W.W.;Hanson, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 15p. (CONF-880364—9). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007118/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

We have used GaAs and GaAs:Cr photoconducting detectors (PCDs) to measure the absolute x-ray output from 1-10 keV from Z-pinch radiation sources. We calibrated the detectors over the spectral range of 900 eV to 3000 eV and found the spectral response to be constant to within the accuracy of the measurements. The flat spectral response, increased sensitivity (compared with bolometers), and good time response of the PCDs, coupled with their reliability and long lifetimes, have allowed us to acquire absolute x-ray data of significantly higher quality than possible with resistive bolometers or x-ray diodes (XRDs). An added attraction of PCDs is their smooth saturation at high incident x-ray fluxes. Unlike other types of electrical x-ray detectors, this feature allows a PCD to operate over a wide range of incident x-ray powers (10-10(sup 4) W/cm(sup 2). We present results from gas puff Z-pinch experiments on Proto-II and SuperMITE comparing PCD, XRD, and resistive bolometer performance. 12 refs., 4 figs.

30995 **(SAND—88-0087C) High frequency fluoroptic thermometry current sensing for weapon susceptibility testing.** Cernosek, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880555—1).

From EMC expo '88; Washington, DC, USA (10 May 1988).

A high frequency current measurement technique for susceptibility testing is proposed. This technique uses a resistive element to produce a temperature change that is sensed by a fluoroptic thermometer. Laboratory testing has shown that RF currents as small as 1.5 mA are measureable for frequencies up to 10 GHz. Errors bounds in determining the current are 6 dB. 7 refs., 6 figs.

30996 **(SAND—88-0860C) A high dynamic range acousto-optic image correlator for real-time pattern recognition.** Molley, P.A.; Stalker, K.T. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880462—5).

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

The architecture and experimental results for an incoherent acousto-optic image correlator suitable for real-time applications are presented. In the basic architecture, each time a line of the raster scanned input image is fed into the acousto-optic device (AOD), all rows of a digitally stored reference image are read into the system using an array of light emitting diodes (LED's). Thus, the required two-dimensional correltaion is performed as a series of multi-channel 1-D time-integrations in x (performed in the AOD) combined with a multi-channel correlation in y (perpendicular to the AOD axis) using a modified CCD. The LED array and detector modifications which markedly increase the dynamic range are discussed as well as correlator design. Further, a novel memory for storing the reference object is described for rapidly changing templates. Experimental results indicate the architecture is useful for applications in the areas of character recognition and target identification. 8 refs., 8 figs.

30997 **Ultrahigh-resolution, wide-field-of-view optical filter for the detection of frequency-doubled Nd:YAG radiation.** Shay, T.M.; Chung, Y.C. (Los Alamos National Laboratory, CLS-5, MS/E535, Los Alamos, New Mexico 87545). *Optics Letters;* **13**: No. 6, 443-445(Jun 1988).

We report a simple theoretical model for the calculation of the dependence of filter quantum efficiency versus laser pump power in an atomic Rb vapor laser-excited optical filter. We present the calculations for a 532.4-nm Rb filter that can be used to detect the practical and important frequency-doubled Nd:YAG laser. The results of these calculations show that the filter's quantum efficiency is relatively insensitive to the laser pump power. The laser powers required to pump the filter range from 3.6 to 226 mW per square centimeter of filter aperture.

45 EXPLOSIONS AND EXPLOSIVES

30998 **(UCRL—97338) Insights in cratering phenomenology provided by discrete element modeling.** Butkovich, T.R.; Walton, O.R.; Heuze, F.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 11p. (CONF-880654—8).

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

We illustrate the application of discrete element modeling to the analysis of underground explosions which create ejecta and/or subsidence. Graphical results are presented for the effect of the same impulse at three successively increasing depths. We emphasize the differences between such modeling and the use of continuum codes which are unable to capture the fragmentation and ejecta processes. 21 figs., 5 figs.

4501 Chemical

30999 **(AD-A—189156/3/XAB) Investigation of the credibility of in-situ measurements of radial and tangential stress in a salt test bed. Technical report, 19 May 1982-31 December 1985.** Keough, D.D.; DeCarli, P.; Florence, A.L.; Mak, R.; Walter, D.F. (SRI International, Menlo Park, CA (USA)). 31 May 1986. 106p. NTIS, PC A06/MF A01.

Eighteen ytterbium piezoresistant sensors in nine Teflon-steel flatpack stress gage-salt core assemblies were fielded in a spherical HE test in a salt medium. The objective was to examine the credibility of in-situ stress measurements by comparing measured stress with stress inferred from independent particle-velocity measurements and with stress from computational simulations of the experiment. Criteria for gage emplacement were examined by finite-element computational simulation of the emplacement configuration. This simulation indicated that two critical parameters that influence the relationship between free-field stress and the stress in the core at the plane of the stress gage are the bonding of the cores to the native salt and the size of the gage relative to core diameter. Static loading calibration of the stress gages yielded a response essentially the same as static calibrations of ytterbium in uniaxial strain loading. Unloading calibration of the gages showed no hysteresis, unlike the uniaxial strain response of ytterbium foil. A gage sensitivity of .000005 Omega/Omega MPa was found to represent the loading and unloading data and was used to convert the experiment waveforms to stress histories. The experiment produced radial stress histories that are characterized by a slowly rising compression, often containing a precursor of approximately 10 bars (1 MPa), a larger main wave peak of 90 to 350 bars, and a release wave to an apparent tensile stress of 30 to 40 bars.

31000 **(PB—88-863014/XAB) Chemical and biological warfare: general studies. January 1979-April 1988 (Citations from the NTIS data base). Report for January 1979-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 116p. NTIS PC N01/MF N01.

Supersedes PB—87-857850.

This bibliography contains citations concerning federally sponsored and conducted studies into chemical and biological warfare operations and planning. These studies cover areas not addressed in other parts of this series. The topics include production and storage of agents, delivery techniques, training, military and civil defense, and general planning studies. Other published searches in this series on chemical warfare cover detection and warning, defoliants, protection, and biological studies, including chemistry and toxicology. (This updated bibliography contains 250 citations, 39 of which are new entries to the previous edition.)

31001 **(SAND—84-2283C) A method for the analysis of gas trapped in EBW [exploding bridgewire] detonators.** Andrzejewski, W.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880473—3).

From American Defense Preparedness Association Compatibility symposium; New Orleans, LA, USA (18 Apr 1988).

A method for sampling and determination of permanent gases, oxids of carbon and nitrogen, and light hdyrocarbon species in sealed explosive devices is described. The method uses a gas chromatograph equipped with a thermal conductivity detector and mass spectrometer to obtain qualitative and quantitative data. The apparatus used to sample the gas consists of a stainless steel bellows valve modified to hold and puncture the closure disc of an explosive detonator. The gases are concentrated as they diffuse out of the explosive cavity onto a small liquid nitrogen trap containing a porous polymer adsorbent. Limits of detection for nitrogen and nitric oxide have been found to be 0.03 and 0.02 μl (STP), respectively. Water and low molecular weight solvents can be detected, but do not yield quantitative data. Analysis of free volumes on the order of 50 μl are routinely performed. 5 refs., 2 figs.

31002 **(SAND—87-2087C) A compatible encapsulant for explosives.** Wischmann, K.B. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 10p. (CONF-880690—1).

From SAMPE electronic materials and processes conference; Seattle, WA, USA (14 Jun 1988).

Many epoxy resin encapsulants are amine cured; unfortunately, amine cured systems have long-term compatibility problems with certain explosives, i.e., HNS (hexanitrostilbene) and HNAB (hexanitroazobenzene). In response to this problem, an epoxy/anhydride encapsulant was developed that does not rely on amine catalysts. A new catalyst, an organochromium complex, was employed which was found to be compatible with the above explosives. This catalyst provided good cures at temperatures as low as 80{degrees}C; normally epoxy/anhydride systems require curing at temperatures well above 100{degrees}C. Our epoxy/anhydride formulation exhibits low exotherms, long pot life, and can be compounded with glass microballoons to attenuate shock and lower the encapsulant's coefficient of thermal expansion. This paper documents the formulation, physical property characterization, processing, and compatibility studies. 6 refs., 3 figs., 3 tabs.

31003 **(SAND—88-0765C) Thermal decomposition studies of explosives for component applications.** Jungst, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 39p. (CONF-880365—1). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007201/JAW.

From Center for Explosives Technology Research seminar series; Socorro, NM, USA (25 Mar 1988).

The explosives PETN and HNS are currently found in a variety of Sandia devices. We have carried out a number of special studies to measure decomposition rates of these materials in hardware at moderate temperatures. The goal of this work was to generate information to enable predictions of component lifetimes to be made. This presentation will discuss sampling and measurement techniques for decomposition products and show results of their application to components containing PETN and HNS.

31004 **Physical kinetics.** Walker, F.E. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Applied Physics;* **63**: No. 11, 5548-5554(1 Jun 1988). Contract W-7405-ENG-48.

The elucidation of the chemistry and physics of shock-induced chemical reactions and the initiation and detonation of chemical explosives has been slow and difficult. The processes involved often are not in thermal equilibrium, and they do not obey Arrhenius kinetics in the usual sense. Some calculations show a slow step in the transfer of shock energy to intramolecular vibrons from the lattice phonons that may limit reaction rates to around 10^7—10^9 s^{-1}. Data and arguments are presented from Hugoniot and detonation studies that support a new concept of high-temperature kinetics. It is proposed that the averaged vibrational velocities of the atoms in condensed systems under the influence of high-velocity shock waves constrain the chemical reaction rates in the systems. This new concept is compared with alternative explanations and contrasted with Arrhenius processes.

31005 **Competition between curvature and chemistry in a spherically expanding detonation.** Bukiet, B.; Jones, J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **52**: No. 22, 1921-1923(30 May 1988).

The methods of bifurcation theory and asymptotic analysis are used to study curvilinear perturbations of a plane detonation wave. An asymptotic model is derived for the small curvature limit. The nonlinear competition between curvature and chemistry is manifested by a highly degenerate critical point in the state space of the model equations. Computer simulations are presented showing agreement of this model with the reactive Euler equations in the small curvature limit. In particular, we find that the leading order correction to the wave speed due to the curvature of the detonation front depends on the order of the chemical reaction to leading order in curvature.

31006 **Hugoniot and shock sensitivity of a plastic-bonded TATB explosive PBX 9502.** Dick, J.J.; Forest, C.A.; Ramsay, J.B.; Seitz, W.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Applied Physics;* **63**: No. 10, 4881-4888(15 May 1988).

The plane shock response of PBX 9502 was measured from 0.5 to 25 GPa. The explosive is 95-wt. % triamino-trinitrobenzene powder coated with Kel-F 800 plastic; porosity was 2.6%. Shock initiation sensitivity, the Hugoniot, and dynamic yield behavior were studied. Experiments done were explosively driven wedge tests and particle velocity history measurements using electromagnetic gauges at a light-gas gun. A new analysis of the wedge test was implemented. Based on wedge test results, an approximation for the particle velocity at the shock front is constructed, which is used in functional composition with the Hugoniot to calculate the shock path of each experiment. Optimization on the parameters of the approximation and the Hugoniot simultaneously ensures agreement of the Hugoniot with the overall kinematics of the shock growth as well as the particle velocity/shock velocity data. The individual shock paths are used to examine the single-curve buildup assumption; the assumption is not valid for PBX 9502. A ramping elastic precursor of 0.073 GPa strength was observed. The yield and weak shock behavior are interpreted in terms of porosity, crystalline anisotropy, and residual strain in the pressed, plastic-bonded explosive.

4502 Nuclear

REFER ALSO TO CITATION(S) 30528, 30529

31007 **(AD-A—189718/0/XAB) Methods for determining particle-size distributions from nuclear detonations. Master's thesis.** Fore, C.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). Mar 1987. 101p. (AFIT/GNE/PH—87M-2). NTIS, PC A06/MF A01.

Samples were analyzed using Photon Correlation Spectroscopy (PCS). The average diameter of the sample particles analyzed with this method ranged from 0.196 to 0.310 microns. Selected samples were also analyzed using Transmission Electron Microscopy (TEM). The data from these analyses were fit to a cumulative log normal distribution with mean diameters ranging from 0.160 to 0.217 and betas ranging from 0.61 to 0.77. Finally, results received from a commercial vendor (Brookhaven Instruments Incorporated) who analyzed two samples using PCS indicate a biomodal distribution with mean particle diameter ranging from 0.296 to 0.298 microns with beta ranging from 0.37 to 0.75. The mean diameter for this analysis ranged from 0.198 to 0.350 microns.

31008 **(PB—88-182274/XAB) Radiakraeknedosa: omprogrammerad version (radiac calculator).** Hulten, G.; Jonsson, G.; Ulvsand, T. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Sep 1987. 34p. (In Swedish). (FOA-E—40035). NTIS, PC E03/MF A01.

A calculator, HP41CV, was modified for radiac calculations. The radiac calculator has fixed programs for calculation of intensities, doses, nuclear fallout fields, weapon yield, and radii for damage. The report shows the equations used, but it is primarily a users' guide.

31009 **(SAND—87-1176) Description of ground motion data processing codes: Volume 1: Nevada Nuclear Waste Storage Investigations Project.** Sanders, M.L. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 207p.

Data processing codes developed to process ground motion at the Nevada Test Site for the Weapons Test Seismic Investigations Project are used today as part of the program to process ground motion records for the Nevada Nuclear Waste Storage Investigations Project. The work contained in this report documents and lists these codes and verifies the {open quotes}PSRV{close quotes} code.

31010 **(UCRL—98309) A possible relation between sonic velocity measured at the edge of a large borehole and shear failure.** Rambo, J.T.; Swift, R.P. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 20p. (CONF-870961—10).

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

Velocities of P-waves measured next to the walls of large-diameter boreholes with the dry-hole acoustic logger are typically lower than velocities across similar geologic media measured farther from the borehole wall using other techniques (Vibroseis). The difference in velocity is attributed to a weakened zone around the borehole wall, which in part may be due to disturbance from drilling and, in part, to the relief of overburden stresses in the vicinity of the borehole wall. P-wave velocity measurements in alluvium and tuffs show high sensitivities to confining pressures in the range of over-burden stresses for many Nevada Test Site holes. When isotropic strength is assumed, elastic-plastic pressure-dependent strength models suggest that lower velocities should occur next to the borehole wall and that shear failure of the medium is necessary to reduce the mean stress and the P-wave velocity. The borehole walls of many holes appear to have failed sufficiently to relieve overburden stresses in major portions of large-diameter Nevada Test Site (NTS) holes. There are documented cases of radioactive gas proceeding past plug locations. On the basis of this analysis, it is prudent to consider the possibility that the damaged wall of the hole is a pathway. An analysis of the RIOLA and ROQUEFORT Events indicates that radioactivity could have bypasses the plug locations because of a weak annulus. We recommend that, where exact plug locations are not dominated by other factor, plugs be placed in regions where minimal annulus damage has occurred. 19 refs., 12 figs.

31011 **(UCRL-Trans—12203) Your enemy teller.** Vilenskiy, M. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. Translation source information not available . 48p. NTIS, PC A; 03/MF A01.

This is a political pamphlet on Edward Teller and his advocacy of the atomic bomb, atomic bomb testing, beneficial effects of fallout, the "clean" bomb, underground shelters, etc. (DLC)

4503 Explosion Detection

31012 **(CONF-8707152—Vugraphs) Proceedings of the array signal processing symposium: Treaty Verification Program.** Harris, D.B. (comp.). (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 359p.

From DOE/DOE/LLNL array signal processing symposium; Livermore, CA, USA (14 Jul 1987).

A common theme underlying the research these groups conduct is the use of propagating waves to detect, locate, image or otherwise identify features of the environment significant to their applications. The applications considered in this symposium are verification of nuclear test ban treaties, non-destructive evaluation (NDE) of manufactured components, and sonar and electromagnetic target acquisition and tracking. These proceedings cover just the first two topics. In these applications, arrays of sensors are used to detect propagating waves and to measure the characteristics that permit interpretation. The reason for using sensors arrays, which are inherently more expensive than single sensor systems, is two-fold. By combining the signals from multiple sensors, it is usually possible to suppress unwanted noise, which permtis detection and analysis of waker signals. Secondly, in complicated situations in which many waves are present, arrays make it possible to separate the waves and to measure their individual characteristics (direction, velocity, etc.). Other systems (such as three-component sensors in the seismic application) can perform these functions to some extent, but none are so effective and versatile as arrays. The objectives of test ban treaty verification are to detect, locate and identify underground nuclear explosions, and to discriminate them from earthquakes and conventional chemical explosions. Two physical modes of treaty verification are considered: monitoring with arrays of seismic stations (solid earth propagation), and monitoring with arrays of acoustic (infrasound) stations (atmospheric propagation). The majority of the presentations represented in these proceeding address various aspects of the seismic verification problem.

31013 **(SAND—87-3133) NRSA [Norwegian Regional Seismic Array] seismic yield estimation primer.** Wayland, J.R.;Lee, D.O.;Bame, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 119p.

An earthquake or an underground nuclear explosion generates seismic waves that propagate through the earth and thus provide information about the event. An analysis of an event may be accomplished by interpretation of these seismic signals. From this interpretative exercise one can estimate the origin of the event and if an explosion, its yield. There is a need for a primer that will allow the novice to quickly begin making such interpretations. The purpose of this primer is to: (1) provide an introduction to the seismological concepts necessary for the understanding of a seismogram;(2) provide a detailed step by step procedure for the interpretations of seismograms;and (3) provide an understanding of yield estimation.

31014 **(UCID—21345) Bearing estimation studies with the LLNL Kansas seismic array.** Harben, P.E.; Harris, D.B. (Lawrence Livermore National Lab., CA (USA)). 16 Mar 1988. Contract W-7405-ENG-48. 25p.

We study the dependence of array bearing estimates on such parameters as phase type and event size, using 24 events from one particular quarry located 150 km from a small-aperture array in southeastern Kansas. We assess bias and variance in a region known to be geophysically similar to the Russian platform. We find that: (1) bias is largely unaffected by source parameters, and therefore is probably principally controlled by path effects. For P waves, a small variation of bias with shot size may exist; (2) variance appears not to decrease with increasing shot size, and may actually increase; (3) among P, S, and Rg phases, the Rg phase exhibits the smallest bias and variance; (4) high-frequency fundamental and higher-order Rayleigh modes exhibit different biasses, suggesting frequency-dependent lateral refraction along the propagation path; (5) relative excitation of fundamental and first higher Rayleigh modes may be controlled by topographical features.

31015 **Method to estimate the yield of an underground nuclear explosion.** Moss, W.C. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Applied Physics;* **63**: No. 9, 4771-4773(1 May 1988). Contract W-7405-ENG-48.

We have modeled the motion of a spherically diverging shock front, due to a point source explosion, using the Rankine—Hugoniot equations and an assumption about the partitioning of energy in the shocked sphere. Our analysis shows that the yield can be determined from measurements of the time dependence of the position and the particle velocity at the shock front, and the initial bulk density of the geologic medium. We compare and contrast our analysis with another theoretical model and experimental data, and show that our model has the potential to determine the yield accurately over an extended range of time, distance, and geologic media.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

31016 (IC—87/363) Mathematical correlation between variations in solar radiation parameters - I: Daily sums of global radiation and midday global radiation. Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702742/JAW.

An equation that simply relates variations in the daily sums of global radiation and the corresponding midday global radiation data over an arbitrarily chosen location on the Earth is derived from first principles. Although this equation is specifically tailored for periods incorporating only cloudless days, it is modified slightly in order also to suit any period that incorporates either cloudless days or consistently cloudy days or days characterised by consistently distributed cloud patches or any combination of these. Global radiation data for Dar es Salaam, Tanzania, calculated on the basis of the slightly modified version of the equation mentioned above agree with actual measurements to at least 89% if each of the days involved is either fairly cloudless or consistently cloudy or is characterised by fairly consistent cloud patches from sunrise to sunset. This clearly demonstrates that it is quite possible to work out reasonable estimates of the overall global radiation incident on a given area using only the corresponding midday global radiation data for that particular area. (author). 6 refs, 1 fig, 3 tabs.

31017 (IC—87/364) Basic causes of amplitude modulation in climatic/weather parameters. Njau, E.C. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702743/JAW.

The continuous interaction between the Earth's spinning motion and energy from the Sun gives rise to some (heat) energy oscillations in the Earth-atmosphere system (Njau, 1985a; 1985b; 1986a; 1986b). Recent results of large scale analysis of East African climatic records have proved that these oscillations significantly link the Sun to climatic/weather variations by systematically modulating key climatic/weather parameters like rainfall and air temperature (Njau, 1987a; 1987b; 1987c; 1987e; 1987f). In this paper, we re-develop the latter proof using a very different approach based upon theoretical analysis. The analysis has confirmed a general law suggested earlier (Njau, 1987d), that, with an exception of the diurnal cycle, any permanent cycle in the net solar energy incident upon a given part of the Earth-Atmosphere system gives rise to a quasi-permanent cycle whose period is approximately twice that of the former. Quasi-biennial as well as double sunspot cycles are shown to be a possible result of this general law. (author). 35 refs, 1 fig., 2 tabs.

5001 Basic Studies

REFER ALSO TO CITATION(S) 30244, 30781, 30808, 31049

31018 (PNL-SA—15676) Sensitivity studies using Pielke's model for Oresund wind simulations. Doran, J.C. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 5p. (CONF-8710296—1).

From Workshop on Oresund experiment; Uppsala, Sweden (13 Oct 1987).

An earlier simulation of the wind and temperature fields in the {phi}resund region for 5 June 1984 has been carried out and compared with observations. A two-dimensional version of the hydrostatic model developed by R.A. Pielke and his co-workers was used. The model results and the observations both showed the development of a stable boundary layer over the {phi}resund as the wind blew from Sweden toward Denmark. At an elevation of 100 m the wind speed increased over the water and was lower over both Sweden and Denmark. In contrast to this, the behavior of the wind speed at 10 m was considerably more complicated. After an initial acceleration over the cooler water surface, the speed subsequently decreased as the fetch over the {phi}resund increased. The speed decreased still further as the wind encountered land in the Copenhagen region, but then accelerated west of Copenhagen. Although there are some differences between the model results and observations, their principal features compare well. (3 refs., 1 fig.)

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29891, 29892, 29895, 30239, 30241, 30410, 30411, 30525, 30738, 30885, 30900, 30913, 30991, 31125, 31132, 31212, 31213, 31281, 31285

31019 (AD-A—189046/6/XAB) Description of the Building Materials Data Base for Cincinnati, Ohio. Special report. Merry, C.J.; LaPotin, P.J. (Army Cold Regions Research and Engineering Lab., Hanover, NH (USA)). Oct 1986. 88p. (CRREL-SR—86-31). NTIS MF A01.

Availability: Microfiche copies only.

The Interagency Task Force on Acid Precipitation manages the National Acid Precipitation Assessment Program (NAPAP). There are ten Task Groups, one for each of the nine research areas in the National Program and one for international activities (Table 1). The goal of NAPAP is to develop and improve a data base that will help researchers understand the causes and effects of acid deposition and how it can be effectively managed. This work on the acid-rain program has been with the Environmental Protection Agency in support of Task Group G, which looks at Effects on Building Materials and Cultural Resources. A building-materials sampling program for the Cincinnati, Ohio, region was conducted in January and February 1985 to examine the types and amounts of building surface materials exposed to acid deposition. The stratified, systematic, unaligned random sampling approach was used to generate sample points across four sampling frame areas. A minimum of 70 sample points was examined per sampling frame to yield a total sample size of 387 points. Building sizes, surface materials, roof characteristics, roof-mounted apparatus, chimneys, gutters, downspouts and fences were recorded. This report provides an initial summary of the data collected.

31020 (AD-A—189162/1/XAB) Air-quality Assessment Model (AQAM) verification analysis. Final report, September 1984-March 1986. Daly, M.M.; Haidt, J. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1987. 17p. NTIS, PC A03/MF A01.

During this period, the contractor (RTI) upgraded the Air-Quality Assessment Model, a computer model which assesses air base source emissions and predicts atmospheric dispersion of specific pollutants. The USAFOEHL acquired a VAX 11/780 computer and RTI adapted the model to run on it. The model was enhanced with a user-friendly operating interface and graphical output options. The verification studies find the AQAM System presently hosted on the USAFOEHL mainframe computer to be comparable to the previous AQAM System with minor differences. The computer outputs to this report will be maintained at the USAFOEHL Library on microfiche because they are lengthy and difficult to reproduce. AQAM is ready for worldwide use as a research or special application model with the software being maintained at USAFOEHL. Input data required to run the model will be coordinated with each individual base.

31021 (AD-A—189308/0/XAB) Volatile organic compound (VOC) testing at Building 348, Kelly AFB, Texas. Final report. Fagin, G.T. (Air Force Occupational and Environmental Health Lab., Brooks AFB, TX (USA)). Nov 1987. 73p. (USAFOEHL—87-147EQ0094LEF). NTIS, PC A04/MF A01.

See also AD-B107 170L.

AT the request of HQ AFLC/SGB, the USAFOEHL conducted a stack-sampling survey to determine total volatile organic compounds (VOC) being emitted from the Aircraft Engine Fuel Accessories Repair Test Shop No. 1, Bldg 348, Kelly AFB TX. This sampling would include all emissions from unified fuel-control stands not vented to the carbon absorber (see USAFOEHL Report 86-094EQ00094KEF). Two of ten representative stacks were sampled and these data were applied to the other eight stacks. A worst-case scenario was provided by base personnel. The total VOC emissions for the worst-case scenario is 133.15 lb/hr.

31022 (CEA-R—5417) Fine particles measurement techniques. Application to some atmospheric phenomena. Metayer, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection Technique; Paris-12 Univ., 94 - Creteil (France)). Oct 1987. 245p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753477/JAW.

A continous flow condensation nuclei counter (CNC) was first studied, this device being used for counting submicronic aerosol particles. A model describing heat and mass transfers inside a cooled pipe and the simultaneous condensational growth was developed; a comparison with experimental results showed excellent agreement. This model accounts for the defaults already observed with this type of apparatus. A new method for measuring the size distribution of aerosols with diameter ranging from 0.008 to 0.3 micron m is described. This technique is based upon particles bipolar charging, by contact with ions emitted from a beta source, and a subsequent differential electrical mobility analysis. The selected particles are detected by means of the CNC. A numerical inversion procedure is needed to recover the original aerosol size distribution. This method was compared with those currently in use: Electrical Mobility Analyser and Diffusion Battery.

31023 (CONF-8710287—1) Some techniques of flux measurements from towers. Wesely, M.L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 14p.

From Workshop on measurements of surface exchange and flux divergence of chemical species in the global atmosphere; New York, NY, USA (19 Oct 1987).

Many of the available tower-based methods to measure the air-surface exchange of trace substances have been reviewed in publications concerned with dry deposition and surface energy balance. Much of the discussion in this paper is based on the more detailed descriptions available in these publications or the references cited therein. Traditional micrometeorological approaches are frequently used to measure air-surface exchange of trace chemicals. This paper addresses methods that fall most clearly into the category of micrometeorological techniques: eddy correlation, use of vertical gradients or profiles, and calculations of fluxes from variances of turbulent fluctuations. Inferential approaches are not considered here because they are not sufficiently direct and in fact infer air-surface exchange rates on the basis of parameterization experiments that employ more direct approaches. Use of surrogate surfaces for routine measurements may be possible in certain situations but are not considered in this paper because they do not measure fluxes that are directed upward. For substances for which sensors suitable for standard micrometeorological methods are not available, tracers can be employed to measure bidirectional fluxes in experiments of various designs that often utilize towers. Also, small-scale mass balance studies that treat a large volume as an enclosure of sorts can be employed. 16 refs., 3 figs., 3 tabs.

31024 (DOE/ER/60255—4) [The effecs of atmospheric CO_2 on insect herbivores and their host plants]: Progress report. Lincoln, D.E. (South Carolina Univ., Columbia (USA). Dept. of Biology). Mar 1988. Contract FG09-84ER60255. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007449/JAW.

Assay procedures for analysis of four groups of allelochemicals in Artemisia tridentata, big sagebrush, were established. Growth of Artemisia under high and low light at three CO_2 levels demonstrated that this species also undegoes a "dilution" of the leaf nitrogen content and is useful as test species for herbivory response to CO_2 induced effects. The initiial experiment also showed that high irradiance is a necessary growth condition. Plants from a single population of A. Tridentata were grown at the Duke Phytotron in three CO_2 regimed and fed to two species of grasshoppers. Sagabrush plants grew more and had lower leaf nitrogen contents as CO_2 concentration increased. However, the plants had on average lowere leaf carbon as well as lower leaf niitrogen contents with elevated CO_2. The source of the lower leaf nutritional value does not appear to be solely an increase in carbon content. Grasshopper consumption was greater on leaves from elevated future and from reduced historical CO_2 regimes, compared to the current concentration. The increased consumption of leaves from elevated CO_2 is in agreement with previous results. Grasshopper consumption was significantly related to leaf allelochemical content, but not to leaf nitrogen content. The consumption difference among CO_2 regimes appeared to result from allelochemical differences, which in turn may result from genetic variation or from CO_2 treatments. 17 refs., 2 figs., 4 tabs.

31025 (DOE/NBB—0083) A primer on greenhouse gases. Wuebbles, D.J.;Edmonds, J. (Lawrence Livermore National Lab., CA (USA); Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract W-7405-ENG-48;AC06-76RL01830. 106p.

This document provides a reference summarizing current understanding of basic information for information greenhouse gases. Each of the gases included is recognized to be important to the future state of global atmospheric chemistry and climate. Included as greenhouse gases are thoses of direct radiative importance to climate, thoses that act as radiative precursors, and those of importance as intermediate constitutents because of their chemical activities. Knowns, unknowns and uncertainties for each gas are described. This document focuses on information relevant to understanding the role of energy and atmospheric chemical and radiative processes in the determination of atmospheric concentrations of greenhouse gases.

31026 (LBL—24582) Real-time measurement of aerosol black carbon during the Carbonaceous Species Methods Comparison Study, Citrus College, Glendora, California, August 12-21, 1986: Final report. Hansen, A.D.A.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 15p.

During the period August 12-21, 1986, the Atmospheric Aerosol Research Group of Lawrence Berkeley Laboratory participated in the Carbonaceous Species Method Comparison Study (CSMCS) conducted at Citrus College, Glendora, California. The equipment that we used was the aethalometer, an instrument developed at LBL that measures the concentration of aerosol black carbon in real time. In this report we present our results from that study in the form of 1-minute, 1-hour, and multi-hour average concentrations. We found concentrations generally ranging from 2 to 5 μg [BC]m^3, usually with increases in the morning traffic hours. We also observed short-duration (2-15 min) peaks in the black carbon concentration that could be directly attributed to the activity of vehicles in a delivery area less than 50 m from the study site. We conclude that mobile sources were the major contributor to the short- and medium-term variability of aerosol black carbon measured at this site. 5 refs., 5 figs., 1 tab.

31027 (N—88-19829) High resolution infrared absorption spectra of various trace gases present in the upper atmospher of the Earth. Final technical report. Hunt, R.H. (Florida State Univ., Tallahassee (USA)). Apr 1988. 5p. (NASA-CR—182590; NAS—1.26:182590). NTIS, PC A02/MF A01.

The objective of NASA Grant NsG 7473 was to obtain and analyze high resolution infrared absorption spectra of various trace gases present in the Earth's upper atmosphere. The goal of the spectral analysis was to obtain values of absorption line strengths, widths and frequencies of sufficient accuracy for use in upper atmosphere trace gas monitoring. During the early phase of the grant, high resolution spectra were obtained from two instruments. One was the 0.02/cm resolution vacuum grating spectrometer at the Florida State University and the other was the 0.01/cm resolution Fourier transform spectrometer at the McMath solar telescope at the Kitt Peak Observatory. Using these instruments, a considerable amount of spectra of methane and hydrogen peroxide were obtained and analyzed. During the latter years of the project, data taking was halted while efforts were devoted to building a new 0.0025/cm resolution vacuum Fourier transform spectrometer. Progress during this phase of the grant then became greatly slowed due to a lack of suitable graduate students in the program. However, the instrument was completed and brought to the point of producing interferograms.

31028 (ORNL/CDIAC—22) A glossary for carbon dioxide and climate. Millemann, R.E. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 56p.

This glossary contains definitions of selected CO_2-related terms as well as tables containing information related to CO_2climate. Each term is deined first, emphasizing its relationship to CO_2 and climate, and then for many of the terms the definition is followed by a more detailed description. References to the literature from which the definitions were taken are listed at the end of the Glossary.

31029 **(ORNL/TM—10570) The seasonal exchange of carbon dioxide between the atmosphere and the terrestrial biosphere: Extrapolation from site-specific models to regional models.** King, A.W.; DeAngelis, D.L.; Post, W.M. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 297p.

Ecological models of the seasonal exchange of carbon dioxide (CO_2) between the atmosphere and the terrestrial biosphere are needed in the study of changes in atmospheric CO_2 concentration. In response to this need, a set of site-specific models of seasonal terrestrial carbon dynamics was assembled from open-literature sources. The collection was chosen as a base for the development of biome-level models for each of the earth's principal terrestrial biomes or vegetation complexes. The primary disadvantage of this approach is the problem of extrapolating the site-specific models across large regions having considerable biotic, climatic, and edaphic heterogeneity. Two methods of extrapolation were tested. 142 refs., 59 figs., 47 tabs.

31030 **(PB—88-164769/XAB) Fiscal Year 1986 program report: Ohio Water Resources Center.** Stiefel, R.C. (Ohio State Univ., Columbus (USA). Water Resources Center). Aug 1987. 44p. NTIS, PC A03/MF A01.

See also report for FY 85, PB—87-165916.

Water is one of Ohio's most important natural resources, and the State has an adequate supply to meet its immediate needs. The focus of the 86 State Water Research Program was directed at some of these needs. One project examined the simultaneous adsorption and biodegradation that occurs in a three-phase fluidized bed that utilizes immobilized living microorganisms in an aerobic wastewater-treatment process. Another project studied the specific mechanisms that certain bacteria have developed to resist inhibition caused by cadmium in the environment and to investigate the potential that these organisms have in the translocation of this highly toxic metal. A third project developed methodology to determine the impact that seasonal water usage has on the safe yield that can be provided from reservoirs used to supply municipal drinking water.

31031 **(PB—88-169156/XAB) Aerosol formation in aromatic hydrocarbon/NOx systems. Final report.** Seinfeld, J.H.; Flagan, R.C.; Petti, T.B.; Stern, J.E.; Grosjean, D. (California Inst. of Tech., Pasadena (USA)). 26 Jan 1987. 283p. NTIS, PC A13/MF A01.

This report describes the results of a major study aimed at elucidating the aerosol-forming potential of atmospheric aromatic hydrocarbons. Unique data on the aerosol formation in the photooxidation of toluene, m-xylene, ethyl benzene and 1,3,5-trimethyl benzene were obtained. These data illustrate the aerosol-forming potential of each aromatic compound when irradiated both in the absence and presence of pre-existing particles. A theoretical framework to calculate the aerosol yield from an organic photo-oxidation was developed. Data on nucleation suppression were obtained. Simulations of the aerosol behavior in these systems were carried out using a simple integral aerosol model. These simulations generally agreed with experimental observations, with the exception of several experiments with initial particles in the toluene system exhibiting nucleation when simulations did not predict this behavior. The question still remains to be resolved.

31032 **(PB—88-171186/XAB) Research issues identified through the use of mathematical dosimetry models: ozone.** Miller, F.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Feb 1988. 22p. (EPA—600/D-88/038). NTIS, PC A03/MF A01.

Knowledge of dose is a fundamental starting point in the evaluation of the toxicity of chemicals, not only for interspecies comparisons but also for designing experiments that elucidate mechanisms of action and that identify issues or research areas for further study. Using a mathematical dosimetry model for ozone, the paper mainly focuses on how models can be used to identify dosimetric research issues and lead to implementation of research projects that address them. Critical to these efforts are sensitivity analyses wherein model parameters are varied and effects on predicted dose are quantified. The use of models to identify research projects and issues reflects an application that may, in the long term, be equally important as the more traditionally recognized function of predicting the dose of a chemical at target sites.

31033 **(PB—88-171194/XAB) Model for comparison of animal and human alveolar dose and toxic effect of inhaled ozone.** Hatch, G.E.; Koren, H.; Aissa, M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Feb 1988. 22p. (EPA—600/D-88/039). NTIS, PC A03/MF A01.

Present models for predicting human pulmonary toxicity of ozone from the toxic effects observed in animals rely on dosimetric measurements of ozone mass balance, and species comparisons of tissue-protective mechanisms against ozone. The goal of this study was to identify a method to directly compare ozone dose and effect in animals and humans using bronchoalveolar lavage (BAL) fluid markers. Feasibility of estimating ozone dose to lung alveoli was demonstrated through assay of reaction products of oxygen-18-labeled ozone in lung surfactant and macrophage pellets of rabbits. Feasibility of using BAL protein measurements to quantify the ozone toxic response in humans was demonstrated by the finding of significantly increased BAL protein in 10 subjects exposed to 0.4 ppm ozone for 2 hr with intermittant periods of heavy exercise.

31034 **(PB—88-171467/XAB) User's guide to the Rough-Terrain Diffusion Model (RTDM) (Rev. 3.20).** Paine, R.J.; Egan, B.A. (Environmental Research and Technology, Inc., Concord, MA (USA)). Jul 1987. 245p. (ERT-P-D—535-585). NTIS, PC A11/MF A01.

For system on magnetic tape, see PB—88-169487.

The User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (Revised 1/88) contains 30 air-quality simulation models. These models input emission and meteorological data to calculate projected air-pollutant concentrations. UNAMAP contains state-of-the-art dispersion research algorithms funded by the EPA's Office of Air Quality Planning and Standards for Environmental Impact Analysis. The manual describes a sequential version of the Rough Terrain Diffusion Model (RTDM, version 3.20). The model provides a method to estimate air-pollutant concentrations from multiple co-located sources in a rural environment. RTDM can be used in flat or complex terrain, but it is especially suited for use in complex terrain.

31035 **(PB—88-171475/XAB) Industrial Source Complex (ISC) Dispersion Model User's Guide. Second edition. Volume 1 (revised). Final report.** Wagner, C.P. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Dec 1987. 275p. NTIS, PC A12/MF A01.

For system on magnetic tape, see PB—88-169487. See also PB—88-171483.

The Second Edition (Revised) of the Industrial Source Complex Dispersion (ISC) Model User's Guide provides a detailed technical discussion of the updated ISC Model. The ISC Model was designed in response to the need for a comprehensive set of dispersion-model computer programs that could be used to evaluate the air-quality impact of emissions from large industrial source complexes. Air-quality impact analyses for source complexes often require consideration of factors such as fugitive emissions, aerodynamic building-wake effects, time-dependent exponential decay of pollutants, gravitational settling, and dry deposition. The ISC Model consists of two computer programs that are designed to consider these and other factors so as to meet the dispersion modeling needs of air-pollution-control agencies and others responsible for performing dispersion-modeling analyses. Major features in the revised model code include: (1) a regulatory default option; (2) a CALMS processing procedure; (3) a new Urban Mode 3; (4) revised sets of wind-speed profile exponents for rural and urban scenarios.

31036 **(PB—88-171483/XAB) Industrial Source Complex (ISC) Dispersion Model User's Guide. Second edition. Volume 2. Appendices (revised). Final report.** Wagner, C.P. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Dec 1987. 306p. NTIS, PC A14/MF A01.

For system on magnetic tape, see PB—88-169487. See also PB—88-171475.

The Second Edition (Revised) of the Industrial Source Complex Dispersion (ISC) Model User's Guide provides a detailed technical discussion of the updated ISC Model. The ISC Model was designed in response to the need for a comprehensive set of dispersion-model computer programs that could be used to evaluate the air-quality impact of emissions from large industrial source complexes. Air-quality impact analyses for industrial source complexes often require consideration of factors such as fugitive emissions, aerodynamic building-wake effects, time-dependent exponential decay of pollutants, gravitational settling, and dry deposition. The ISC Model consists of two computer programs that are designed to consider these and other factors so as to meet the dispersion modeling needs of air-pollution-control agencies and others responsible for performing dispersion-modeling analyses. Major features in the revised model code include: (1) a regulatory default option: (2) a CALMS processing procedure; (3) a new Urban Mode 3; and, (4) revised sets of wind-speed profile exponents for rural and urban scenarios.

31037 **(PB—88-171491/XAB) Discussion of changes to the Industrial Source Complex (ISC) dispersion model user's guide--second edition.** Wagner, C.P. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Dec 1987. 19p. NTIS, PC A03/MF A01.

For system on magnetic tape, see PB—88-169487.

The User's Network for Applied Modeling of Air Pollution (UNAMAP), Version 6 (Revised 1/88) contains 30 air-quality simulation models. These models input emission and meteorological data to calculate projected air-pollutant concentrations. UNAMAP contains state-of-the-art dispersion research algorithms funded by the EPA's Office of Air Quality Planning and Standards for Environmental Impact Analysis. The Industrial Source Complex (ISC) Model has undergone several revisions since first being issued in order to correct and improve technical features and to make the model more appropriate for specific applications. Recent changes to the UNAMAP 6 version of both ISC Short-Term and ISC Long-Term include the ability to model receptors located above ground level (flagpole receptors) and a revised building-downwash treatment method. These changes are covered in the addendum.

31038 **(PB—88-172473/XAB) National air-quality and emissions-trends report, 1986.** Hunt, W.F.; Curran, T.C.; Freas, W.P.; Faoro, R.B.; Frank, N.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1988. 201p. (EPA—450/4-88/001). NTIS, PC A10/MF A01.

See also report for 1985, PB—87-180352.

This report presents national and regional trends in air quality from 1977 through 1986 for total suspended particulate, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. Air-pollution trends were also examined for the 5-year period (1982-86). Both national and regional trends in each of these pollutants are examined. National air-quality trends are also presented for both the National Air Monitoring Sites (NAMS) and other site categories. The report also includes a section, Air Quality Levels in Metropolitan Statistical Areas.

31039 **(PB—88-173364/XAB) Sampling and analysis of hazardous wastes.** Johnson, L.D.; James, R.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Feb 1988. 103p. (EPA—600/D-88/035). NTIS, PC A06/MF A01.

The chapter is a relatively brief overview and guide to the very-complicated endeavor of sampling and analysis of hazardous waste and related products. Stack sampling and analysis of waste combustion products is emphasized partly due to the authors' backgrounds and partly due to the relatively recent development of most of the technology.

31040 **(PB—88-174438/XAB) Quality-assurance support for the National Atmospheric Deposition Program and National Trends Network monitoring activities: 1984-1987.** Bigelow, D.S. (Colorado State Univ., Fort Collins (USA). Natural Resources Ecology Lab.). Jan 1988. 337p. NTIS, PC A15/MF A01.

The quality-assurance support provided to the National Atmospheric Deposition Program (NADP) and to the National Trends Network (NTN) from the period 1984 to 1987 is summarized. The support was provided through a cooperative agreement between the Colorado State University (CSU) and the U.S. Environmental Protection Agency (EPA). The report describes the specific types of QA activities conducted, the development of the support from a historical perspective, and the QA reports and QA data summaries generated.

31041 **(PB—88-174545/XAB) Sodium hydroxide preliminary source assessment.** Neuffer, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1988. 132p. (EPA—450/3-88/002). NTIS, PC A07/MF A01.

A preliminary source assessment of industries with sodium hydroxide emissions is presented. Brief descriptions of these industries and processes that emit sodium hydroxide are given. Sodium hydroxide emissions data that were used in the Human Exposure Model (HEM) are contained in the report. This Model is used by EPA's Pollutant Assessment Branch to evaluate health risks from various pollutants. Sodium hydroxide emission data were primarily obtained from the states of Kentucky, New Jersey, New York and Texas.

31042 **(PB—88-178025/XAB) Determination of total gaseous nonmethane organic emissions as carbon: summary of comments and responses for Method 25.** McAlister, G. (Environmental Protection Agency, Research Triangle Park, NC (USA)). Aug 1987. 21p. (EPA—450/3-87/018). NTIS, PC A03/MF A01.

On November 7, 1986, the U.S. Environmental Protection Agency (EPA) published in the Federal Register (51 FR 40448) the revised Method 25, Determination of Total Gaseous Nonmethane Organic Emissions as Carbon. Public comments were solicited at the time of proposal. To provide interested persons the opportunity for oral presentations of data, views, or arguments concerning the proposed revisions of the test method, a public hearing was scheduled for December 22, 1986, at the Research Triangle Park, North Carolina, but no person desired to make an oral presentation. The public-comment period was from November 7, 1986, to January 21, 1987. Three comment letters were received concerning issues relative to the proposed test methods. A detailed discussion of these comments and responses is summarized in the document. The comments have been carefully considered, and appropriate changes was made in the proposed revision.

31043 **(PB—88-179205/XAB) Health-assessment document for beryllium. Final report.** Bayliss, D.L.; Chen, C.W.; Cogliano, V.J.; Chu, M.M.L.; Elias, R. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Nov 1987. 206p. (EPA—600/8-84/026F). NTIS, PC A10/MF A01.

See also PB—86-183944.

The chemical and geochemical properties of beryllium resemble those of aluminum, zinc, and magnesium. The resemblance is primarily due to similar ionic potentials which facilitate covalent bonding. The three most common forms of beryllium in industrial emissions are the metal, the oxide, and the hydroxide. The main routes of beryllium intake for man and animals are inhalation and ingestion. While the absorption of ingested beryllium is probably quite small, the chemical properties of beryllium are such that inhaled beryllium has a long retention time in the lungs, and thus, a greater potential for absorption. The tissue distribution of absorbed beryllium is characterized by depositions primarily in the skeleton where the biological half-time is fairly long. The lung is the critical organ of both acute and chronic non-carcinogenic effects. However, unlike most other metals, the lung effects caused by chronic exposure to beryllium may be combined with systemic effects, of

which one common factor may be hypersensitization. Certain beryllium compounds have shown carcinogenic activity in various experimental animals by various routes of exposure, but not by ingestion per se. Epidemiologic studies are inadequate to demonstrate or refute a human carcinogenic potential. In terms of the weight-of-evidence for carcinogenicity, beryllium is judged to be in Group B2 signifying that the animal evidence for carcinogenicity is sufficient and that beryllium and its compounds are regarded as probably carcinogenic for humans.

31044 **(PB—88-179866/XAB) Fiscal year 1985 summary report of NOAA (National Oceanic and Atmospheric Administration) Meteorology Division support to the Environmental Protection Agency. Technical memo.** Viebrock, H.J.; Poole-Kober, E.M. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Nov 1987. 62p. (NOAA-TM-ERL-ARL—160). NTIS, PC A04/MF A01.

See also PB—86-101664.

The Meteorology Division provided meteorological research and support to the Environmental Protection Agency. Basic meteorological support consisted of the application of dispersion models, and the conduct of dispersion studies and model evaluations. The primary research effort was the development and evaluation of air-quality simulation models using numerical and physical techniques supported by field studies. Modeling emphasis was on the dispersion of photochemical oxidants and particulate matter on urban and regional scales, dispersion in complex terrain, and atmospheric processes related to the acid-deposition problem. Highlights during FY-1985 included evaluation of the dividing streamline height concept for flow over and around terrain features, completion of the VALMET and MELSAR models for use in specific terrain situations; development of a preliminary version of the Regional Acid Deposition Model (RADM).

31045 **(PB—88-180021/XAB) Air-quality modeling analysis of industrial point sources in Everett, Washington. Final report, June 1987-March 1988.** Hansen, E.B.; Winges, K.D. (TRC Environmental Consultants, Inc., Mountainlake Terrace, WA (USA)). 2 Mar 1988. 43p. NTIS, PC A03/MF A01.

The maximum allowable emissions from operating permits for Scott Paper Company and Weyerhaeuser Company pulp and paper mills in Everett, Washington were obtained from Washington Department of Ecology. A 5-year sequential meteorological data base was prepared using wind data from the Puget Sound Air Pollution Control Agency monitoring station in Everett, surface observations from Sea-Tac Airport, and upper-air data from Quillayute, Washington. The mill's emissions of sulfur dioxide and particulate matter were modeled using the most-recent versions of COMPLEX1, SHORTZ, and ISCST to determine: (1) if the existing monitoring site was located such that maximum concentrations are measured; and (2) if existing permit limits on emissions were sufficient to ensure compliance with State and Federal ambient air-quality standards.

31046 **(PB—88-180039/XAB) Development and testing of the CBM-IV (Carbon-Bond Mechanism) for urban and regional modeling. Final report, July 1985-June 1987.** Gery, M.W.; Whitten, G.Z.; Killus, J.P. (Systems Applications, Inc., San Rafael, CA (USA)). Mar 1988. 431p. NTIS, PC A19/MF A01.

The development and testing of an updated Carbon Bond Mechanism (CBM) is described. The new mechanism, called CBM-IV, was designed for use in EPA's OZIPM-EKMA model. The mechanism, however, is also suitable for use in large air-quality simulation models such as the Urban Airshed Model and EPA's Regional Oxidant Model. The mechanism differs from earlier versions of the CBM in that the chemistry of aromatic hydrocarbons has been significantly altered to account for the sensitivity of ozone formation to the organic-to-NOx ratio. A new condensed chemistry for isoprene has also been incorporated into the mechanism. The CBM-IV was tested against 200 smog-chamber runs that were conducted in outdoor and indoor smog-chamber facilities. The mechanism was found to yield good agreement to the experimental data for a wide variety of organic systems over a wide range of organic-to-NOx ratios.

31047 **(PB—88-180062/XAB) Evaluation and assessment of UNAMAP (User's Network for Applied Modeling of Air Pollution). Report for July 1986-November 1987.** Baumann, R.E.; Dehart, R.K. (Battelle Columbus Div., OH (USA)). Mar 1988. 237p. NTIS, PC A11/MF A01.

The Evaluation and Assessment of UNAMAP is a study to determine how best to improve the usefulness and availability of the UNAMAP air-pollution dispersion models. This report describes a plan for implementing a series of recommended improvements to the UNAMAP program. It also describes the earlier parts of the study upon which the plan is based. The study consisted of a technology assessment followed by data collection and analysis that were used to develop the strategy and the specific improvements contained in the plan. The overview includes a summary of the data collected during the study, and the conclusion, drawn from analysis of that data. The analysis indicates that improvements to UNAMAP are needed in the areas of: (1) model accuracy; (2) model documentation; (3) user support; (4) data collection; (5) data input; and, (6) computer compatibility. The report describes a plan which is based on a strategy that is consistent with the long-term objectives for UNAMAP. The report contains a strategic framework for improving UNAMAP. The strategic framework guides the implementation and strikes a balance between the goals of advancing dispersion-modeling research and transferring technology to the public. Included in the plan is a set of ten specific recommended improvements that are described and broken into specific tasks. Estimates of time and cost required to implement each improvement are given at the task level. Finally, the recommended improvements are grouped into three phases. A schedule is presented at the task level for the five recommended improvements in Phase 1.

31048 **(PB—88-180138/XAB) Precision and accuracy assessments for state and local air-monitoring networks, 1986. Annual report.** Rhodes, R.C.; Evans, E.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Jan 1988. 90p. (EPA—600/4-88/007). NTIS, PC A05/MF A01.

See also PB—87-145447.

Precision and accuracy data obtained from State and local agencies during 1986 are summarized and evaluated. Some comparisons are made with the results reported for prior years to determine any trends. Some trends indicated continued improvement in the completeness of reporting precision and accuracy data. The national summaries indicate a further improvement in the precision and accuracy assessments of the pollutant monitoring data collected. The annual results from each reporting organization are given so that comparisons may be made from year to year.

31049 **(PB—88-180146/XAB) Geophysical monitoring for Climatic Change Number 15. Summary report 1986.** Schnell, R.C.; Rosson, R.M. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Air Resources Lab.). Dec 1987. 168p. NTIS, PC A08/MF A01.

See also Summary Report 1985, PB—87-162533.

At MLO, a major addition was construction of a 40-m walk-up tower to be used to increase the height of certain air-sampling intakes and as a platform for special experiments. An astronomical dome and associated observation building were installed for the University of Arizona solar-monitoring program. At BRW, new programs included weekly ozonesondes and gas chromatographs for in-situ monitoring of CH_4, CFC-11, CFC-12, N_2O, CH_3CCl_3 and CCl_4. The Dobson spectrophotometer used for total column ozone observations was reinstalled. Special efforts were made to support the AGASP-II field program and for monitoring the radioactive cloud from the Chernobyl nuclear accident.

31050 **(PB—88-181169/XAB) Positive advection schemes for environmental studies.** van Stijn, T.L.; Praagman, N.; van Eijkeren, J. (Ministerie van Verkeer en Waterstaat, The Hague (Netherlands). Dienst Informatieverwerking). 31 Mar 1987. 18p. (SWA—87/044). NTIS, PC E03/MF A01.

The study of air- and water-quality models in geophysical flows often give rise to advection-diffusion-reaction equations. The method of fractional steps (Yanenko) makes it possible to separate

these processes and to employ for each physical mechanism an efficient numerical technique. In this paper the advective part of the set of equations is investigated. It is well-known that it is difficult to design an appropriate advection scheme. The authors present a comparative study of a number of special numerical methods that approximate the solution of the advection equation with two spatial dimensions.

31051 **(PB—88-181672/XAB) Intercomparison of methods for the measurement of carbonaceous aerosol species. Final report.** Appel, B.R.; Cheng, W.; Tokiwa, Y.; Salaymeh, F.; Povard, V. (California Dept. of Health Services, Berkeley (USA). Air and Industrial Hygiene Lab.). Jan 1987. 77p. NTIS, PC A05/MF A01.

Errata sheet inserted.

The principal goal of the study, as part of the Carbonaceous Species Methods Comparison Study, was to perform field trials at Citrus College, Glendora, CA, in August 1986 with a sampler intended to minimize positive and negative artifacts for sampling particulate carbon. In addition, organic and elemental carbon in atmospheric and laboratory-generated samples were analyzed to permit intermethod comparisons. The particulate carbon sampler consisted of a cyclone, parallel-plate diffusion denuder packed with coarse, activated alumina, and a quartz-fiber filter followed by a fluidized bed of activated alumina. The sampler failed to perform effectively in atmospheric trials; alumina showed little activity in decreasing the positive error in filter carbon sampling due to sorption of gas-phase carbonaceous material. The measurement of organic (Co) and elemental carbon (Ce) employed an optical absorption technique for Ce and a coulometer for total C (Ct). Organic carbon was then obtained by difference between Ct and Ce. In addition, organic and elemental carbon in atmospheric and laboratory-generated samples were analyzed to permit intermethod comparisons.

31052 **(PB—88-181961/XAB) Procedures for sprinkler anchor installation on surfaces with fireproofing materials.** Mathey, R.G.; Knab, L.I.; Gross, J.L.; Small, J.A. (National Bureau of Standards, Washington, DC (USA)). Feb 1988. 76p. (NBSIR—87/3676). NTIS, PC A05/MF A01.

Procedures were developed for limiting the release of fibers from fireproofing material during sprinkler hanger anchor installation on steel deck/concrete floor slab surfaces. These procedures were needed by the General Services Administration (GSA) for installation of sprinkler systems in buildings having fireproofing containing asbestos. A prototype floor slab having spray-on friable mineral wool fireproofing was used in laboratory tests. The mineral-wool fireproofing was used as a model system for fireproofing containing asbestos. The various combinations of mechanical anchoring procedures (use of drills or powder-actuated gun) and encapsulation procedures tested limited the fiber release to a range of values of 0.000 to 0.055 f/cc (fibers per cubic centimeter) as compared to a range of values of 0.26 to 0.82 f/cc for procedures without encapsulation. Encapsulation was shown to be effective as evidenced by much higher levels of fiber release during testing without encapsulation. Because there is no known correlation between the release of mineral-wool fibers and asbestos fibers, it was recommended that the procedures developed be evaluated by GSA in buildings having fireproofing containing asbestos. An air-sampling protocol was developed for use by GSA in evaluating the procedures in the field. Subsequently field tests were conducted by GSA. The laboratory and field studies provided GSA with an effective procedure, measurement method, and decision tool for installing sprinkler hanger anchors in steel deck/concrete floor slabs having fireproofing materials.

31053 **(PB—88-182001/XAB) Offshore and Coastal Dispersion (OCD) Model, Version 3.0 (revised 1988). Model-Simulation.** Baer, M. (Minerals Management Service, Reston, VA (USA)). Aug 1985. mag tap. NTISCP T08.

Supersedes PB—85-246106; Source tape is in the ASCII character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions. Price includes documentation, PB—88-182019.

The Offshore and Coastal Dispersion Model was adapted from the EPA guideline model MPTER to simulate the effect of offshore emissions from point sources in coastal regions. Modifications were made to incorporate overwater plume transport, dispersion, and changes that occur as the plume crosses the shoreline. Modifications included the use of turbulence intensities to define dispersion regimes, use of the RTDM Model to treat plume reflection in elevated terrain, use of the BLP Model to incorporate building downwash and plume rise to the model. The model is written in the FORTRAN programming language for implementation on a AMDAHL V7 Computer using the VSV7 operating system.

31054 **(PB—88-182381/XAB) Effect of solvent and extraction methods on the bacterial mutagenicity of sidestream cigarette smoke.** Morin, R.S.; Tulis, J.J.; Claxton, L.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 15p. (EPA—600/J-87/256). NTIS, PC A03/MF A01.

Pub. in Toxicology Letters, Vol. 38, 279-290(1987).

The mutagenic activity of sidestream cigarette-smoke particles was estimated by testing sidestream cigarette-smoke particles that had been collected under controlled burning conditions in the laboratory. Two different extraction methods (Soxhlet and ultrasonic agitation) and 3 different solvents (dichloromethane, methanol, and acetone) were compared for their efficiencies in the extraction of compounds from sidestream cigarette-smoke particles that are mutagenic in the Ames test. The mutagenic activity of the sidestream smoke particles was estimated to be 15,000-20,000 revertants per cigarette in TA98 with metabolic activation and 12,000-17,000 revertants per cigarette in TA100 without metabolic activation.

31055 **(PB—88-183330/XAB) Evaluation of potential toxic air contaminants. Phase 1. Final report. Report for July 1985-September 1986.** Rogozen, M.B.; Rich, H.E.; Guttman, M.A.; Grosjean, D. (Science Applications International Corp., Manhattan Beach, CA (USA)). 23 Dec 1987. 582p. (SAIC—76/1035). NTIS, PC A25/MF A01.

The California Air Resources Board has identified 25 Level 2 potential toxic air contaminants that require additional documentation to determine whether further regulatory action is necessary. The objectives of this study were to obtain information on the use, emissions, ambient concentrations, and atmospheric chemistry of the Level 2 contaminants; identify data deficiencies; and recommend future field measurements, surveys, modeling, and laboratory experimentation to reduce data gaps. Compounds highly recommended for further investigation include acetaldehyde, acrolein, chlorinated benzenes, cresols, dialkyl nitrosamines, glycol ethers, methyl bromide, phenols, phosgene, and xylenes.

31056 **(PB—88-183751/XAB) Polycyclic aromatic hydrocarbons (PAH): a candidate toxic air contaminant. Technical report.** Propper, R. (California State Air Resources Board, Sacramento (USA). Stationary Source Div.). Mar 1988. 14p. (ARB/SS—88-01). NTIS, PC A03/MF A01.

See also PB—84-194869.

The State of California's Air Resources Board has classified PAH (polycyclic aromatic hydrocarbons) as a candidate toxic air contaminant (TAC). The report was prepared as background information to help determine whether PAH should be actively reviewed for possible identification as a TAC. The report consists of the following sections: (1) A summary of basic facts regarding PAH, (2) Chemistry and monitoring (sampling and analysis) methods, (3) Studies of ambient air for PAH, (4) A health effects summary, and (5) References. Ambient data are provided for overall PAH, naphthalene, benzo(a)pyrene, particular nitro-PAHs, and mutagenic density. Most of the data for emission sources and ambient concentrations are for California air.

31057 **(PB—88-184601/XAB) State-of-the-art flue-gas-cleaning technologies for MSW (municipal solid waste) combustion.** Brna, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Mar 1988. 30p. (EPA—600/D-88/051). NTIS, PC A03/MF A01.

The paper discusses state-of-the-art flue-gas cleaning technologies for municipal solid waste (MSW) combustion. The control of air pollutants from the combustion has evolved from none or only particulate control to current systems controlling acid gases, trace

organics, trace heavy metals, and nitrogen oxides, as well as particulate matter. Both in-furnace and post-combustion control methods for limiting one or more of these pollutants are discussed. Test results for various control-technologies are reported. Recent control technology applications and trends are noted.

31058 **(PB—88-185020/XAB) Determination of acidity in ambient air, Phase 2. Final report, 1 February 1985-31 December 1987.** Appel, B.R.; Tokiwa, Y.; Povard, V.; Kothny, E.L. (California Dept. of Health Services, Berkeley (USA). Air and Industrial Hygiene Lab.). Sep 1987. 140p. (CA/DOH/AIHL/SP—47). NTIS, PC A07/MF A01.

See also report dated Dec 84, PB—85-218196.

A laboratory and field study was conducted as part of a continuing assessment of methodologies for measurement of gaseous and particulate acids in the atmosphere. The acidic species included the gases nitric acid (HNO_3), nitrous acid (HONO), hydrochloric acid (HCl) and the particulate phase species, sulfuric acid. Nitric acid measurement by the automated tungstic acid technique (TAT) was evaluated for interferences due to NO, NO_2 and HONO. Loss of nitric acid in passage through various types of Teflon tubing as well as within a variety of cyclones was also studied. The annular denuder method (ADM) for HNO_3 was compared to the denuder difference method (DDM). An effort was made to assess NO_2 interference in HONO measurement with the ADM.

31059 **(PB—88-185269/XAB) Technical guidance for corrective measures: determining appropriate technology and response for air releases. Draft report (Final).** Arienti, M.; Baldwin, A.; Kravett, M. (Alliance Technologies Corp., Bedford, MA (USA)). Mar 1985. 216p. (GCA-TR—85-43-G). NTIS, PC A10/MF A01.

The purpose of this guidance document is to assist EPA/State personnel in implementing the new corrective action provisions by providing a central source of information on air-emissions control technologies and techniques for hazardous-waste treatment, storage, and disposal facilities.

31060 **(PB—88-185509/XAB) Investigation of product-layer diffusivity for CaO sulfation.** Borgwardt, R.H.; Bruce, K.R.; Blake, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 10p. (EPA—600/J-87/279). NTIS, PC A02/MF A01.

Pub. in Industrial and Engineering Chemistry Research 26, 1993-1998(1987).

This paper gives results of comparisons of the sulfation rates of CaO prepared from $Ca(OH)_2$ and $CaCO_3$, using six types of each precursor derived from the same natural limestones. The particles were small enough to eliminate all transport resistances except diffusion through the $CaSO_4$ product layer. No significant difference between the reactivity of the two types of CaO was observed when compared at equal values of specific surface area (23 sq m/g), temperature (800C), and SO_2 partial pressure (304 Pa). The apparent product-layer diffusivity at these conditions was 2.1×10^{-8} sq cm/sec. For an activation energy of 33 kcal/mol, the Arrhenius pre-exponential factor for diffusion is estimated to be 0.12 sq cm/sec. Sulfation rates increased with the 0.64 power of SO_2 partial pressure.

31061 **(PB—88-188107/XAB) Study of application rates of aerosol and pump hair sprays. Final report, July 1986-November 1987.** Boggs, R.R.; Belmont, B. (American Research and Testing, Inc., Gardena, CA). 11 Mar 1988. 259p. NTIS, PC A12/MF A01.

Application rates of three hair spray dispensing systems, aerosol, pump, and Exxel packaging were determined through a six-week user panel of approximately 300 people. In addition, photochemically reactive organic compounds (PROC) application rates were determined through chemical analysis of the products. The user panel was stratified on the basis of sex, dispenser (pump/aerosol), and age (adult/teen). Weighted-application rates and weighted PROC application rates are included. A Mann-Whitney evaluation was made to evaluate differences between data sets. Product-usage data for both male and female adult groups support the conclusion that increased use of either pumps or Exxel packaging for hair spray would reduce PROC emissions in California. Data from adult groups also indicate that use of Exxel packaging in place of pumps would not reduce PROC. Consumer preference was also sampled. Adult pump users were not very willing to switch to aerosols, but on the order of half of aerosol users were willing to switch to pumps.

31062 **(PB—88-190509/XAB) International Sulfur Deposition Model Evaluation. Final report, May 1987.** Clark, T.L.; Dennis, R.L.; Voldner, E.C.; Olson, M.P.; Seilkop, S.K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). May 1987. 267p. (EPA—600/3-87/008). NTIS, PC A12/MF A01.

Also pub. as Atmospheric Environment Service, Downsview (Ontario) rept. no. AES/PUB/ARD-87-1. See also report dated July 1987, PB—87-212742; Errata sheet inserted.

The International Sulfur Deposition Model Evaluation (ISDME) project, jointly conducted by the U.S. Environmental Protection Agency and Atmospheric Environment Service of Environment Canada, assessed the performance of eleven linear chemistry atmospheric models in predicting amounts of sulfur wet deposition. Standardized model input data sets were distributed to the participating modelers, who later submitted seasonal and annual 1980 model predictions of dry/wet deposition and air concentrations of sulfur dioxide and sulfate at up to 65 sites across eastern North America. The models were evaluated in an operational mode using new, more-rigorous approaches, as well as the more-conventional distribution statistics recommended by the American Meteorological Society. The new approaches focused on the ability of the models to replicate features of the spatial patterns of sulfur wet deposition, as determined by an interpolation technique known as kriging. The technique quantified the uncertainties in the observations used in the evaluation process to identify areas where interpolated predictions were statistically significantly different from the interpolated observations. To supplement the evaluation, predictions of dry-deposition amounts and air concentrations of each model were intercompared to identify apparent peculiarities.

31063 **(PB—88-860275/XAB) Toxicology of ozone. January 1970-March 1988 (citations from the NTIS data base). Report for January 1970-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 197p. NTIS PC N01/MF N01.

Supersedes PB—87-851176.

This bibliography contains citations concerning laboratory and field investigations of the toxic effects of ozone. Topics include effects on forests, agricultural crops, humans, and laboratory animals. Synergism with other atmospheric pollutants such as oxides of sulfer and nitrogen is discussed. Occupational exposure, dosage, and effects on pulmonary and respiratory systems in humans and animals are also presented. (This updated bibliography contains 374 citations, 36 of which are new entries to the previous edition.)

31064 **(PB—88-862479/XAB) Polychlorinated biphenyls in the environment. May 1986-April 1988 (Citations from the NTIS data base). Report for May 1986-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 60p. NTIS PC N01/MF N01.

Supersedes PB—87-857918.

This bibliography contains citations concerning sources, distribution, and transport of polychlorinated biphenyls (PCBs) in the environment. Topics include site surveys to assess the extent of pollution problems in specific areas, toxicology, detection and removal methods, and environmental-impact studies. Water- and air-pollution surveys are treated. (This updated bibliography contains 103 citations, 49 of which are new entries to the previous edition.)

31065 **(PNL-SA—15688) Overview of the PRECP [PRocessing of Emissions by Clouds and Precipitation] Program.** Hales, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 9p. (CONF-880351—3).

From NAPAP atmospheric chemistry task group review; Knoxville, TN, USA (13 Mar 1988).

The PRocessing of Emissions by Clouds and Precipitation (PRECP) Program addresses the scientific understanding and quantitative description of the physical and chemical storm processes that lead to deposition of pollutants to the earth's surface. These processes are primary determinants of source-receptor transport distances and of the chemical forms, concentrations, and wet-deposition loadings of pollutants at receptor sites. The importance of each of these features to NAPAP, both for policy analysis and for input to scientific studies of receptor response, are largely self-evident. A brief description of the program is presented.

31066 **(PNL-SA—15692) Composite, meso-gamma scale diagnostic modeling.** Easter, R.C.; Lindsey, C.G. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1988. Contract AC06-76RL01830. 9p. (CONF-880351—4).

From NAPAP atmospheric chemistry task group review; Knoxville, TN, USA (13 Mar 1988).

We are attempting to demonstrate an overall understanding of pollutant processing by clouds and precipitation through diagnostic modeling of individual case studies. Through these modeling studies, we will obtain information on the relative importance of different scavenging processes and the relations between pollutant inflows to and outflows from clouds. A significant aspect of this work is that we are modeling scavenging and cloud chemistry processes within meteoro-logically complex situations on a scale where cloud-scale motions are treated explicitly. The scavenging simulations with the PLUVIUS-II model have focused on the processing of sulfur species. The simulations involve four pollutant species: sulfur dioxide (SO_2), sulfate aerosol, hydrogen peroxide (H_2O_2), and ozone. Ammonia and nitric acid were not included in the simulations. Besides gas and aerosol forms, the species can be dissolved or bound in any of the water forms treated in the CSU model: cloud water, rain, graupel, snow (aggregates), and ice crystals. The scavenging processes included in the model for these species are impaction and nucleation scavenging of aerosols, reversible gas scavenging, aqueous chemical reactions between SO_2, H_2O_2, and ozone, and cloud microphysical processes that transfer water and pollutants from one form to another. 2 refs., 3 figs., 1 tab.

31067 **(UCRL—97988) Standardization of branch exposure chambers: Basic performance specifications, test procedures, and field implementation.** Houpis, J.L.; Surano, K.A. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 15p. (CONF-8711135—2). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88005427/JAW.

From Workshop on the use of branch exposure techniques in air pollution studies; Boulder, CO, USA (11 Nov 1987).

Branch exposure chambers can be used to explore the impact of air pollution on mature trees. Although comparison of experimental results would be facilitiated by the use of a single design for branch exposure chambers, adoption of a single design is unlikely because of the need for the chambers to be applicable to a wide variety of locations, species, and scientific questions. To facilitate comparisons of results from chambers of different designs, investigators should adhere to standards in three areas. These areas of standardization include chamber performance tolerance limits, testing procedures, and field implementation. Performance tolerance limits are specifications of design, quality assurance, and field use with regard to internal and external conditions of branch exposure chambers. Once these limits have been determined, standardized testing procedures will insure minimal variablity between chambers of different designs. Standardization in field implementation will reduce the variability that arises from the use of BECs in different studies. 8 refs., 1 tab.

31068 **Winter cloud water and air composition in central Ontario.** Strapp, J.W.; Leaitch, W.R.; Anlauf, K.G.; Bottenheim, J.W.; Joe, P.; Shemenauer, R.S.; Wiebe, H.A.; Isaac, G.A.; Kelly, T.J.; Daum, P.H.; and others. (Atmospheric Environment Service, Downsview, Ontario, Canada). *Journal of Geophysical Research;* **93**: No. D4, 3760-3772(20 Apr 1988).

Time histories of surface air composition and cloud water composition in winter in Central Ontario are compared in order to establish a winter data set for this region, and to identify dominant processes responsible for the incorporation of sulfate, nitrate, and acidity into cloud water. Cloud water comparisons are restricted to low-level collections (median altitude 625 m above ground) within the boundary layer. Surface level measurements during the 6-week period show a variety of conditions, including several episodes of elevated concentrations of SO_2, NO_3^-, HNO_3, aerosol SO_4/sup =/, and occasionally aerosol NO_3^-. Nitric acid comprised the majority of soluble acidity at ground level more than half the time, and was relatively more important during the periods of elevated SO_4/sup =/ and NO_3^- concentrations. Examination of cloud water composition indicated that HNO_3 was also the dominant contributor to cloud water acidity on the majority of days sampled. Comparisons of air and cloud water absolute concentrations and concentration ratios suggest that aqueous SO_2 oxidation was of minor importance in determining cloud composition. The conclusion is supported by measurements of hydrogen peroxide in cloud water samples. Cloud water NO_3^- SO_4/sup =/ ratios were found to exceed (HNO_3 + aerosol NO_3^-)SO_4/sup =/ ratios in air at the surface in most cases, and in a few instances cloud water NO_3^- concentrations were higher than expected based on the surface air composition data; several possible causes for this observation are discussed. It is concluded that in this region in winter, the composition of low-level clouds can be estimated to within a factor of 2 by measurements of air composition at the surface, and that dissolution of soluble aerosol and gaseous species is primarily responsible for cloud composition.

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REFER ALSO TO CITATION(S) 30147, 30237, 30468

31069 **(AERE-R—12478) Studies of environmental radioactivity in Cumbria. Part 15. The variation of radionuclide atmospheric deposition with distance from the sea.** Pattenden, N.J.; Cambray, R.S.; Playford, K. (UKAEA Harwell Lab. Environmental and Medical Science Div.; Department of the Environment, London (UK)). Jun 1987. 51p. (DOE-RW—87.086). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753088/JAW.

Five stations collecting samples of atmospheric deposition were set up in north Cumbria along a line running inland from the coast for about 17 km. Sampling was continuous from September 1980 to September 1981. Monthly samples were analysed for ^{106}Ru, ^{137}Cs, ^{144}Ce, ^{238}Pu, sup(239,240)Pu, ^{241}Am, ^{7}Be and stable Na, Cl and Al. The objective of the work was to measure the deposition of radionuclides as a function of distance from the sea. By estimating the contributions to the deposition of nuclear weapon test material and of the atmospheric discharges from the British Nuclear Fuels plc works at Sellafield, the effects of the transfer to air and land of radionuclides in the sea could be established. The marine radionuclides were due to the discharges to sea from the Sellafield works. The measurements showed that the deposition was largely due to the sea-to-land transfer process. The highest depositions observed were at 20 m from high water mark, the annual values (rounded, in Bq m^{-2}) being ^{106}Ru, 500; ^{137}Cs, 650; plutonium, 70; ^{241}Am, 30. The highest concentrations in rainwater for the radionuclides studied were less than 3 per cent of the fresh water limits (drinking only) GDL values. The highest estimated accumulations in soil due to atmospheric deposition were less than 1 per cent of the limits.

31070 **(CONF-880505—3) A model for global cycling of tritium.** Killough, G.G.; Kocher, D.C. (Hendecagon Corp., Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 23p.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

Dynamic compartment models are widely used to describe global cycling of radionuclides for purposes of dose estimation. In this paper, we present a new global tritium model that reproduces environmental time-series data on concentrations in precipitation, ocean surface waters, and surface fresh waters in the northern hemisphere, concentrations of atmospheric tritium in the soutehrn hemisphere, and the latitude dependence of tritium in both hemispheres. Named TRICYCLE for Tritium CYCLE, the model is based on the global hydrologic cycle and includes hemisphereic stratospheric compartments, disaggregation of the troposphere and

ocean surface waters into eight latitudezones, consideration of the different concentrations of atmospheric tritium over land and over the ocean, and a diffusive model for transport in the ocean. TRICYCLE reproduces the environmental data if we assume that about 50% of the tritium from atmospheric weapons testing was injected directly into the northern stratosphere as HTO. The models latitudinal disaggregation permits taking into account the distribution of population. For a unfiormaly distributed release of HTO into the worldwide troposphere, TRICYCLE predicts a collective dose commitment to the world population that exceeds the corresponding prediction by the NCRP model by about a factor of 3. 11 refs., 5 figs., 1 tab.

31071 **(LBL—24179) Parametric modelling of temporal variations in radon concentrations in homes.** Revzan, K.L.; Turk, B.H.; Harrison, J.; Nero, A.V.; Sextro, R.G. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 21p. (CONF-871006—49). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007373/JAW.

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

The ^{222}Rn concentrations in the living area, the basement, and the undelying soil of a New Jersey home have been measured at half-hour intervals over the course of a year, as have indoor and outdoor temperatures, wind speed and direction, and indoor-outdoor and basement-subslab pressures; in addition, periods of furnace opration have been logged. We generalize and extend an existing radon entry model in order to demonstrate the dependence of the radon concentration on the environmental variales and the extent of furnace use. The model contains parameters which are dependent on geological and structural factors which have not been measured or otherwise determined; statistical methods are used to find the best values of the parameters. The non-linear regression of the model predictions (over time) on the measured living area radon concentrations yields an R{aup 2} of 0.88. 9 refs., 2 figs.

31072 **(LBL—24345) Appraisal of the US data on indoor radon concentrations.** Nero, A.V.; Revzan, K.L.; Sextro, R.G. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 11p. (CONF-871208—3).

From 4. international symposium on the natural radiation environment; Lisbon, Portugal (7 Dec 1987).

Monitoring efforts undertaken before 1985 indicate that the radon concentration U.S. houses averages apporximately 55 Bq m/sup {minus/3} and that, in approximately 6%, annual-average levels eceed 150 Bq m/sup {minus/3}, with perhaps 1 to 2% having 300 Bq m/sup {minus/3} or more. However, several recent large-scale data sets yield average concentrations of 100 to 150 bq m/sup {minus/3}, with perhaps 20% of results exceeding 150 Bq m/sup {minus/3}, leading many to conclude that the U.S. frequency distribution is substantially higher than previously indicated. In fact, this conclusion is unfounded, and the public,policy makers, and even scientists are being misled by inappropriate use of data. In particular, these recent data sets overrepresent high-concentration houses or include sampling performed in basements or in the winter only. Adequate information is not available to adjust these results precisely to annual-average indoor concentrations experienced by the population, but plausible corrections yield results that are consistent with the distributions previously found. (6 refs., 1 fig.)

31073 **(PB—88-171178/XAB) Status of EPA (Environmental Protection Agency) radon-mitigation demonstration program.** Craig, A.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Feb 1988. 11p. (EPA—600/D-88/037). NTIS, PC A03/MF A01.

This paper discusses the portion of EPA's radon-reduction technology development/demonstration program dealing with the study of reduction methods for existing and new construction houses. The EPA program has as its objective the development and demonstration of cost-effective radon-reduction techniques applicable to existing and new construction houses, all housing substructure types, a wide range of house design and construction features, a range of initial radon concentrations, a variety of radon-mitigation approaches, and a scope that is national. The program, which started on a small scale in 1984, is divided into four major areas: methods for radon entry diagnosis and reduction performance testing, reduction methods for existing houses, reduction methods for new houses, and program support and information transfer. After 1 year of study, a matrix was developed to try to systematize a very complex problem. As a result of the development of the matrix, it appears that at least 600 houses will need to be studied to cover all the variables to a satisfactory degree, making the mitigation of essentially any housing type possible. The number will be studied over a period of 5-8 years.

31074 **(PB—88-173455/XAB) Criteria for a recommended standard - occupational exposure to radon progeny in underground mines.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1987. 225p. (DHHS/PUB/NIOSH—88-101). NTIS, PC A10/MF A01.

Also available from Supt. of Docs.

This document contains the criteria for establishing and complying with a National Institute for Occupational Safety and Health (NIOSH) recommended standard for controlling exposures to radon progeny in underground mines. It addresses the following topics: recommendations for radon progeny standard, basis for the recommended standard, research needs, and public-health perspectives. The appendices to the document present information concerning epidemiologic studies, quantitative risk assessment, engineering control methods, sampling strategy, and medical aspects of wearing respirators.

31075 **(RISO-M—2673) RIMPUFF.** Thykier-Nielsen, S.; Mikkelsen, T. (Risoe National Lab., Roskilde (Denmark)). Oct 1987. 154p. Risoe Library, DK-4000 Roskilde.

An operational puff diffusion model, RIMPUFF (Risoe Mesoscale PUFF model) has been developed at Risoe National Labortory to provide risk and safety assessments in connection with e.g. nuclear installations. The computer model releases a sequence of puffs with individual pollutant and heat contents, then calculates the time-dependent concentration field, which is provided by the collection of puffs. The puffs are advected through a three-dimensional grid on the basis of a time sequence of measured horizontal wind vectors. The model code is written in standard FORTRAN 77 for a Burroughs B7800 computer. The code also runs on a VAX or a IBM computer. The input data consists of two data files with parameter specifications. In addition, data files with precalculated wind fields and population distribution can be provided. The model outputs for doses, puff positions wind and concentration fields consists of disk files and printed data. Graphical presentation of results is based on a specific program, which creates background maps, wind vector plots, puff plots and isoconcentration contours. 24 refs.

31076 **(SCPRI-RM—8-1987) Monthly results of measurements, August 1987.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Aug 1987. 50p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753080/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

31077 **(SCPRI-RM—9-1987) Monthly results of measurements, September 1987 with supplement related to 1987 third quarter.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Sep 1987. 78p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753081/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface waters, underground water, drinking water, sewage water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites, sediments. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobyl accident.

5006 Regulations

REFER ALSO TO CITATION(S) 30412, 31074, 31105

31078 **(PB—88-179288/XAB) Residential wood heaters - background information for promulgated standards.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Nov 1987. 131p. (EPA—450/03-87/025). NTIS, PC A07/MF A01.

The report contains background technical information used in establishing standards of performance for residential wood heaters as proposed under the authority of Sections 101, 111, 114, and 301 of the Clean Air Act, as amended.

31079 **(PB—88-179320/XAB) Assessment of risk caused by remedial actions considered for Vertac Chemical Corporation site, Jacksonville, Arkansas.** Falco, J.W.; Schaum, J.L. (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Dec 1984. 40p. (EPA—600/6-88/002). NTIS, PC A03/MF A01.

The purpose of this study is to assess the risk caused by dust emissions associated with proposed remedial actions considered for the Vertac Chemical Corporation site in Jacksonville, Arkansas. Much of the site is contaminated with 2,3,7,8-TCDD as a result of the materials handling, waste disposal, and other operations associated with the pesticide production at the site since the 1950's. The proposed remedial action involves excavation of the contaminated areas and redisposal in a secure landfill. These actions would disturb the soil, creating the potential for dust emissions. The study estimates the possible emission rates, uses dispersion models to predict resulting off-site air concentrations, and finally, calculates the exposure/risks caused by these emissions.

31080 **(PB—88-181094/XAB) Standards and guides of air pollution control. Volume 1. Manual 1971-85.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 30 Jan 1987. 282p. (LIR—01-87/243). NTIS, PC A13/MF A01.

See also Volume 2, PB—88-181102.

Thirty nine (39) important Federal and New York State documents concerning air pollution control are compiled. More specifically, the Federal Clean Air Act PL 95-396, Guidelines for the Control of hazardous ambient-air contaminants, NY Air Quality Standards, etc., etc. are included.

31081 **(PB—88-181102/XAB) Standards and guides of air pollution control: Volume 2. Manual 1966-81.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 30 Jan 1987. 228p. (LIR—01-87/245). NTIS, PC A11/MF A01.

See also Volume 1, PB—88-181094; Portions of this document are not fully legible.

Five (5) important documents concerning air pollution control are compiled. More specifically, Computer-Aided Air Quality Management, Predicting the Dispersion of Airborne Effluents for Environmental Management, Air Pollution Control Laws of New York State, Summary of Proposed New Rule for Iron and/or Steel Processes, and Summary of Proposed Revision for Processes and Exhaust and or Ventilation Systems.

31082 **(PB—88-181557/XAB) Compendium of Superfund field-operations methods. Final report.** Feldt, L. (Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response). Dec 1987. 644p. (EPA—540/P-87/001). NTIS, PC A99/MF A01.

This Compendium provides Superfund Remedial Project Managers (RPM), quality assurance officers, and State officials with a consolidated ready reference for all remedial field procedures at uncontrolled hazardous-waste sites. It is also intended to contribute to improved consistency in field procedures among the ten EPA Regions.

31083 **(PB—88-182209/XAB) Summary of the 1986 EPA (Environmental Protection Agency) National Performance Audit Program on source measurements. Final report.** Streib, E.W.; Mitchell, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Jan 1988. 43p. (EPA—600/4-88/003). NTIS, PC A03/MF A01.

See also report for 1985, PB—87-165254.

In 1986, the Quality Assurance Division conducted the National Audits for Stationary Source Test Methods. The audit materials consisted of: a disposable gas cylinder for Method 3 (Orsat analyzer), a calibrated orifice for Method 5 (DGM only), five simulated liquid samples each for Method 6 (SO_2) and Method 7 (NOx), and two coal samples for Method 19. Participating laboratories sent their data to the Source Branch and, in return, received a written report comparing their results to EPA's. In the Method 3 audit, each parameter had only one concentration. The mean for CO_2 was 3.7% from the expected (EPA) value. The mean for O_2 was 0.4%. In the Method 5 audit, the mean value for all participants differed by 3.9% from the expected value. For the Method 6 audit, the average mean differed by 2.0% from the expected value, and in the Method 7 audit, the average mean differed by 5.0%. In the two coal audits, the parameters measured were sulfur, moisture, ash, and Btu content. On the average for the sulfur analysis, 90% of the participants measured within 10% of the expected value; for Btu, 99% of the participants measured within 10% of the expected value.

31084 **(PB—88-183173/XAB) Economic impact of the proposed generic rule R86-18. Final report.** Goodkind, M.E.; White, R.; Wang, I.T. (Impell Corp., Lincolnshire, IL (USA)). Feb 1988. 177p. NTIS, PC A09/MF A01.

This economic-impact study assesses the costs and benefits associated with amendments to existing state air-pollution-control regulations Parts 211 and 215, as proposed by the Illinois Environmental Protection Agency (IEPA). Three proposals have been presented to the Illinois Pollution Control Board: an original and an alternative proposal presented by IEPA and a modified version of IEPA's alternative proposal submitted by the Illinois State Chamber of Commerce Environmental Regulatory Group (ERG). The IEPA has proposed the following control requirements: (1) emission capture and control with overall reduction in VOM emissions of at least 81%; or (2) for coating lines, emissions of VOM not to exceed 3.5 lb/gal of coating material; or (3) an adjusted RACT limit based on an economic justification submitted by the facility. The proposed rules would apply in the major urban areas of Chicago and St. Louis.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

5101 Basic Studies

31085 **(CONF-8708224—1) Ecological risk factors related to environmental uses of genetically engineered organisms.** Sharples, F.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 29p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006674/JAW.

From Meeting on bioaugmentation as a means to enhanced waste treatment; New Orleans, LA, USA (30 Aug 1987).

The purpose of this paper is to discuss some of the ecological questiosn and conerns related to environmental applications of biotechnology. There are a number of uncertainties about the risks entailed in the use of such products. These uncertainties arise principally because of gaps in the knowledge bases in basic ecology, microbial biology and ecology, genetics, and risk assessment. The need to ensure that the benefits of biotechnology products are safely realized and that their environmental applications do not result in new sources of environmental degradation provides the fundamental rationale for systematic assessments of risk before field testing or commercial use. 16 refs., 1 tab.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 30088, 30089, 30136, 30149, 30411, 30911, 30914, 31029, 31123

31086 (PB—88-174446/XAB) Treatment potential for 56 EPA (Environmental Protection Agency) listed hazardous chemicals in soil. Final report, 1 September 1983-28 February 1987. Sims, R.C.; Doucette, W.J.; McLean, J.E.; Grenney, W.J.; Dupont, R.R. (Utah State Univ., Logan (USA). Dept. of Civil and Environmental Engineering). Feb 1988. 120p. NTIS, PC A06/MF A01.

Information is presented for quantitative evaluation of soil-treatment potential for 56 hazardous chemicals. The chemicals were organized into four categories: PAH, pesticides, chlorinated hydrocarbons, and miscellaneous chemicals. Treatability studies were conducted to determine: degradation rates, phase-partition coefficients, and transformation characteristics. Results of soil fate/transport predictions of two mathematical models were compared with laboratory and literature results to evaluate ability of models to predict behavior of selected chemicals. The experimental approach used was designed to characterize degradation, immobilization, and transformation potentials for the hazardous substances. Results indicated that significance of volatilization and abiotic-loss processes in influencing apparent loss rates of substances depended on class of substance. The processes were insignificant for majority of PAHs; biodegradation appears to be major process for PAH loss. Abiotic loss may also be important process for certain pesticides.

31087 (PB—88-862982/XAB) Hazardous waste treatment and disposal. January 1970-April 1988 (Citations from the US Patent data base). Report for January 1970-April 1988. (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 47p. NTIS PC N01/MF N01.

Supersedes PB—87-858981.

This bibliography contains citations of selected patents concerning methods and equipment utilized in the treatment and disposal of liquid and solid hazardous materials. Thermal treatment, encapsulation, storage, and monitoring of hazardous wastes are described. While the majority of the material pertains to chemical wastes, some attention is given to radioactive materials. (This updated bibliography contains 85 citations, 17 of which are new entries to the previous edition.)

31088 (PB—88-863089/XAB) Sanitary landfills. January 1978-April 1988 (Citations from the NTIS data base). Report for January 1978-April 1988. (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 188p. NTIS PC N01/MF N01.

Supersedes PB—87-859054.

This bibliography contains citations concerning the design, operation, and management of sanitary landfills. Topics include liner materials evaluations, leachate analyses, site studies, environmental monitoring, and solid-waste-management strategies. Coal-conversion and electric utility waste products, municipal refuse, and dredged-materials disposal are considered. Considerable attention is given to methane-recovery operations. Citations pertaining specifically to land disposal of hazardous materials are excluded. (This updated bibliography contains 364 citations, 31 of which are new entries to the previous edition.)

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 30028, 30031, 30033, 30070, 30078, 30079, 30088, 30089, 30145, 30149, 30150, 30375, 31076, 31077

31089 (AERE-G—4307) Study of uranium series disequilibrium in core profiles and mineral separates from the samples of Lac du Bonnet granite from the URL site, Pinawa, Manitoba, Canada. Ivanovich, M.; Longworth, G.; Wilkins, M.A.; Hasler, S.E. (UKAEA Harwell Lab. Nuclear Physics Div.; Department of the Environment, London (UK)). Dec 1987. 61p. (DOE-RW—87.077). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753083/JAW.

Uranium series disequilibrium measurements of actinide activities and activity ratios have been used to study the geochemical history of Lac du Bonnet granite, from the URL site, Pinawa, Canada. Measurements on core profiles between fractured surfaces and the parent rock show that the granite underwent high temperature events several million years ago, followed by more recent low temperature events within the last million years. The main locations for the rock/water interaction and exchange of actinides are the fracture surfaces. The results of similar measurements on separated mineral phases show that the 'soft' minerals such as biotite and feldspar are more vulnerable to weathering than the 'hard' accessory minerals such as zircon.

31090 (ORNL/TM—10592) Investigation of background radiation and associated anomalies in Rifle, Colorado. Smuin, D.R.;Wilson, M.J.;Crutcher, J.W. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 61p.

In addition to examining anomalies and establishing the background gamma exposure rate range, the study presents a formula to convert thousand counts per minute (kcpm) from a gamma scintillator to microroentgen per hour (μRh) for the Rifle region. Also, a method is presented to identify contaminated areas containing excess ^{226}Ra, by using a GR-410 gamma spectrometer. This method is suggested to be applied to all property surveys in the Rifle area. The Wasatch Formation, which outcrops extensively in the Rifle area, was found to have a major influence on the background radiation. Varying potassium concentrations and naturally occurring uranium in this rock unit reveal varying gamma exposure rates. Examining RaTh ratios from laboratory analysis of soil samples or use of RaTh ratios from GR-410 gamma spectrometer readings on site allows discrimination between mill related contamination and naturally occuring radioactivity. Radioactive coal clinkers were found used as fill material throughout the Rifle region and have been determined to be a product of the mill and subject to remediation. Finally, windblown mill tailings contamination is addressed in some detail. Mill tailings redistributed from the Rifle uranium mill tailings piles by prevailing winds were detected extensively on vicinity properties in Rifle. Some radioactive components of the windblown tailings were found to have leached into the subsurface soil. The combination of Wasatch Formation, radioactive coal clinkers, and windblown tailings accounts for many of the anomalous gamma exposure rates observed by the radiological survey teams. 11 refs., 10 figs., 3 tabs.

31091 (SAND—87-0843) Environmental thermoluminescent dosimetry measurements at the WIPP [Waste Isolation Pilot Plant] Site, 1976-1985. Thompson, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1988. Contract AC04-76DP00789. 52p.

In 1975, the US Energy Research and Development Administration began evaluating a site in southeastern New Mexico for the possible construction and operation of a Waste Isolation Pilot Plant. The purpose of the facility was to test and demonstrate the operations and technical principles of a permanent repository in bedded salt for ERDA-generated transuranic radioactive waste. An extensive preoperational environmental study program to document the region's meterorology, geology, hydrology, flora and fauna, existing air and water quality, and background radiation was undertaken by Sandia National Laboratories. The purpose of this document is to report the final results of environmental thermoluminescent dosimeter measurements performed from January 1976 through December 1985. The final results were obtained by re-evaluating the quarterly raw data using a uniform analysis procedure. 6 refs., 4 figs., 2 tabs.

31092 (STUK-A—58) Radioactivity of milk, meat, cereals and other agricultural products in Finland after the Chernobyl accident in 1986. Supplement 3 to Annual Report STUK-A55. Rantavaara, A.; Haukka, S. (Finnish Centre for Radiation and Nuclear Safety, Helsinki). Jun 1987. 110p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753028/JAW.

The paper describes the surveillance of radioactive substances in agricultural products in Finland after the end of April 1986. The main objective was to assess the dietary intake of fallout radionuclides via milk, meat, cereals and eggs in Finland during the

period May-December 1986. In spring 1986 the sampling programmes were extended on the basis of the continuous surveys carried out earlier. The sampling of different types of produce covered a considerable part of the main production areas. The frequency of the sampling was greatly increased from that in previous years, specially in spring and summer, in order to follow the temporal variation in the contents of radionuclides in milk and meat. Gamma-emitting radionuclides, especially "1"3"1I, "1"3"4Cs and "1"3"7Cs, were measured on all samples. "8"9Sr and "9"0Sr were determined on the milk and cereal samples used for nationwide assessments. The mean dietary intakes of radionuclides in May-December 1986, calculated from the average consumption of foodstuffs in Finland and the nationwide production-weighted mean mean contents of radionuclides. Contamination of agricultural products due to fallout radionuclides did not cause any restrictions for their use in Finland.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 30091, 31371

31093 **(DOE/EIS—0125-F-Summ.) Intertie development and use: Final environmental impact statement: Summary.** (USDOE Bonneville Power Administration, Portland, OR). Apr 1988. 16p.

The Intertie Development and Use (IDU) Final Environmental Impact Statement (EIS) examines the environmental effects of three proposed Bonneville Power Administration (BPA) actions with respect to the use and development of the Pacific Northwest/Pacific Southwest Intertie. The actions are: expansion of the capacity of the Intertie; adoption of a Long-Term Intertie Access Policy (IAP), which will set the ground rules for use of the Intertie by utilities other than BPA for short- and long-term transmission of surplus power to California; and decisions by BPA to enable, through its access policies and marketing efforts, various types and levels of firm power marketing between the Northwest and California.

31094 **(LA—11156-MS) Evidence of young fault movements on the Pajarito fault system in the area of Los Alamos, New Mexico.** Wachs, D.; Harrington, C.D.; Gardner, J.N.; Maassen, L.W. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 25p.

Los Alamos lies along and upon the Pajarito fault system, a major intragraben structure of the Rio Grande rift. This fault system consists of over 100 km of interconnected fault zones and traces. Geomorphic evidence, including righ-lateral steps in stream valleys and disrupted drainages, as well as apparent vertical offset of alluvial units determined by seismic refraction, strongly suggests that the Pajarito fault zone is active. To evaluate seismic hazards in the Los Alamos area, values for recurrence intervals and characteristic earthquakes of the faults must be determined. We recommend the trenching of young alluvium in Rendija and Guaje canyons to obtain information regarding recurrence of the characteristic earthquake. 23 refs., 9 figs.

31095 **(PNL—6494) Descriptions of plant communities at the proposed reference repository location and implications for reclamation of disturbed ground.** Rickard, W.H.; Schuler, C.A. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 25p.

This report presents an ecological description of the natural vegetation in the Cold Creek Valley located in the west central portion of the US Department of Energy's (DOE) Hanford Site in southeastern Washington state. The description includes plant species composition, canopy cover, and shrub density obtained from 10 study plots distributed in three habitat-types: sagebrush/Sandberg's bluegrass, spiny hopsage/Sandberg's bluegrass, and sagebrush/needle-and-thread grass. Of the relatively few species of shrubs and herbs in the Cold Creek Valley, the most abundant were sagebrush and spiny hopsage. The most abundant herbs were cheatgrass, Sandberg's bluegrass, and needle-and-thread grass. The amount of canopy cover provided by shrubs ranged between 7.4 and 33% in seven plots without a history of recent burning. Herbaceous plants in these same plots provided canopy cover that ranged between 18 and 41%. The three plots placed in areas with a recent history of burning had more herbaceous cover than did adjacent plots without a recent burn history. This was attributed to absence of living shrubs and freedom from competition for soil water and nutrients. There was less living herb cover in 1987 than in 1986 which is likely due to the lesser amount of growing season precipitation in 1987 (i.e. 10.3 cm vs 17.1 cm). Even with the absence of livestock grazing for 44 years, cheatgrass, an exotic annual generally provided more canopy cover than native perennial grasses. However, in the few places with good stands of Sandberg's bluegrass, cheatgrass was less abundant. 12 refs., 6 figs., 6 tabs.

31096 **(PNL—6495) Habitat associations of vertebrate prey within the controlled area study zone.** Marr, N.V.; Brandt, C.A.; Fitzner, R.E.; Poole, L.D. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 24p.

Twelve study locations were established in nine habitat types in the vicinity of the proposed reference repository location. Eight species of small mammals were captured. Great Basin pocket mice (Perognathus parvus) comprised the majority of individuals captured, followed by deer mice (Peromyscus maniculatus), Northern pocket gopher (Thomomys talpoides), Western harvest mouse (Reithrodontomys megalotus), Grasshopper mouse (Onychomys leucogaster), Montane vole, (Microtus montanus), House mouse (Mus musculus), and the Bushy-tailed woodrat (Neotoma cinerea). Pocket mice were captured in all habitats sampled; deer mice were obtained in all habitats save hopsage and nearly pure cheatgrass stands. The highese capture rates were found in bitterbrush and riparian habitats. Capture sex ratios for both pocket mice and deer mice were significantly different from equality. Body weights for deer mice and pocket mice exhibited a great deal of heterogeneity across trap sites, although only the heterogeneity for pocket mice was significant. In general, body weights for both species were greater in the sagebrush habitats than elsewhere. These differences are interpreted in light of habitat evaluation methodologies. Six species of reptiles and one species of amphibian were captured. Side-blotched lizards (Uta stansburiana) were by far the most frequently captured species. The predominant snakes captured were the yellow-bellied racer (Coluber constrictor) and the Great Basin gopher snake (Pituophis melanoleucus). Two Great Basin spadefoot toads (Scaphiopus intermontanus) captured at the Rattlesnake Springs trap site. Species diversity was quite low (Shannon-Wiener H {equals} 1.03). Side-blotched lizards were found in all habitats save near the talus on Gable Mountain and on the gravel pad site. The only other lizard species [northern sagebrush lizard (Sceloporus graciosus) and short-horned lizard (Phrynosoma douglasii)] were obtained in bitterbrush habitat. 20 refs., 1 fig., 9 tabs.

31097 **(PNL—6496) Productivity, mortality, and response to disturbance of nesting Swainson's hawks on the Hanford Site.** Poole, L.D.; Marr, N.V.; McCorquodale, S.M. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 30p.

The objectives of this study were to characterize Swainson's hawk (Buteo swainson) use of the US Department of Energy (DOE) Hanford Site and to evaluate the potential for engineering and other human activities on the Hanford Site to negatively affect the nesting Swainson's hawk population. Activities associated with the Basalt Waste Isolation Project (BWIP) were used as the primary external stimuli in studying hawk responses to potential human disturbance. Parked and moving vehicles were the most common disturbance sources observed in Swainson's hawk territories. Hawks appeared to be sensitive to disturbance from pedestrians and slow-moving vehicles near nests. Novel stimuli were much more likely to evoke strong responses than were recurring events. Adult hawks reacted more frequently and vigorously than did juveniles. When disturbed, adult hawks usually flew toward the location of the disturbance; juvenile hawks usually flew away from disturbances. Human activity associated with BWIP may have had negative on one pair of nesting Swainson's hawks and may have precluded the use of an additional traditional nesting territory. Negative impacts to nesting Swainson's hawks from human activity could be minimized by confining activities to the non-nesting period or to distances greater than 2.2 km from nest sites. Tree groves and elevated perches, including utility poles, across the Hanford Site are probably critical to the success of nesting

Swainson's hawks. Potential mitigation strategies associated with energy research and development activities on the Hanford Site could include provisions for maintenance and establishment of drought-tolerant trees and native vegetation. 22 refs., 5 figs., 3 tabs.

5106 Regulations

REFER ALSO TO CITATION(S) 30412, 31082, 31171, 31172, 31173, 31175, 31176, 31177

31098 **(PB—88-176128/XAB) RPM (Remedial Project Manager) primer: an introductory guide to the role and responsibilities of the Superfund Remedial Project Manager. Final report.** Roe, C.H. (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Sep 1987. 46p. (REPT—9355.1-02). NTIS, PC A03/MF A01.

The purpose of the document is to familiarize new Remedial Project Managers (RPMs) with their roles and responsibilities in the Superfund remedial program. It also can serve as an orientation to the Superfund remedial program for EPA program staff, and the public. It is not intended to be a training document. EPA has developed other materials and conducts courses specifically for training purposes. The Acme Waste Disposal Co. site, the people, and the events described in the document are hypothetical and were created to depict the cleanup of an abandoned hazardous-waste site. The example illustrates typical Superfund remedial response activities and was written to demonstrate specifically the important role of the RP in managing site cleanup and in coordinating the various participants. Key terminology and concepts appear in bold face. For simplicity, the example depicted in the Primer is a Fund-financed, Federal-lead project from start to finish. In reality, a project may switch from Fund- to Enforcement-lead, and from Federal- to State-lead during the remedial process, thereby altering roles of the participants. In addition, the example portrays the RPMs involvement with only one site, when an RPM actually may be involved with several concurrent projects.

31099 **(PB—88-178066/XAB) Guidelines for disposal of solid wastes and hazardous wastes (Volume 1). Report for 1973-1981.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 20 Jan 1987. 238p. (LIR—01-87/230). NTIS, PC A11/MF A01.

See also Volume 2, PB—88-178074.

These documents are compiled as Guidelines for Disposal of Solid Wastes and Hazardous Wastes: (1) Landfill Disposal of Solid Waste; (2) Hazardous Waste Guidelines and Regulations; (3) Solid Waste Management Facility Guidelines; (4) Refuse-Energy Systems with Resource Recovery as Alternatives to Landfill; (5) Sanitary Landfill - Planning, Design, Operation, & Maintenance; (6) Recycler's Handbook; (7) Guidelines for Landfill of Toxic Industrial Sludges.

31100 **(PB—88-178074/XAB) Guidelines for disposal of solid wastes and hazardous wastes. Volume 2.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 1 Feb 1987. 353p. (LIR—02-87/238). NTIS, PC A16/MF A01.

See also PB—88-178066, and Volume 3, PB—88-178082.

These documents are compiled as the Guidelines for Disposal of Solid Wastes and Hazardous Wastes, Volume II: (1) The Federal Resource Conservation and Recovery Act PL 94-580; (2) Use and Disposal of Municipal Wastewater Sludge; (3) Solid-Waste-Management Facilities; (4) Regulations Relating to Solid Waste Management Facilities; (5) Sludge Management Practices in New York State.

31101 **(PB—88-178082/XAB) Guidelines for disposal of solid wastes and hazardous wastes. Volume 3. Report for 1980-1981.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 14 Feb 1987. 238p. (LIR—02-87/240). NTIS, PC A11/MF A01.

See also Volume 2, PB—88-178074, and Volume 4, PB—88-178090.

These documents are compiled as the Guidelines for Disposal of Solid Wastes and Hazardous Wastes: (1) Toxic Substances Control Act; (2) Regulations for Siting of Industrial Hazardous Waste Facilities; (3) Proposed Adoption of Regulations for Siting Industrial Hazardous Waste Facilities; (4) Collection and Transport of Industrial, Commercial and Certain Other Wastes; (5) Regulations Relating to the Use, Reporting and Recordkeeping Requirements Associated with the Hazardous Wastes Manifest System and Related Standards of Generators, Transporters, and Facilities Dealing with Hazardous Waste; (6) Environmental Impact Statement, Regulatory Impact Statement, Hazardous Waste Manifest System, and Standards Applicable to Hazardous-Waste Generators and Transporters; (7) Regulations Relating to the Identification and Listing of Hazardous Wastes.

31102 **(PB—88-178090/XAB) Guidelines for disposal of solid wastes and hazardous wastes. Volume 4. Report for 1975-1985.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 27 Feb 1987. 289p. (LIR—02-87/241). NTIS, PC A13/MF A01.

See also Volume 3, PB—88-178082, and Volume 5, PB—88-178108.

These documents are compiled as the Guidelines for Disposal of Solid Wastes and Hazardous Wastes: (1) Hazardous Waste Management System: General; (2) Identification and Listing of Hazardous Wastes; (3) A Summary of Hazardous Substance Classification Systems; (4) Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities; (5) Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements.

31103 **(PB—88-178108/XAB) Guidelines for disposal of solid wastes and hazardous wastes. Volume 5.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 27 Feb 1987. 263p. (LIR—02-87/242). NTIS, PC A12/MF A01.

See also Volume 4, PB—88-178090.

These documents are compiled as the Guidelines for Disposal of Solid Wastes and Hazardous Wastes, Volume V: (1) Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities; (2) Interim Status Standards for Owners and Operators of Hazardous Waste Facilities.

31104 **(PB—88-184684/XAB) Status of SITE program demonstrations.** Lewis, N.M.; Hill, R.D. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Mar 1988. 23p. (EPA—600/D-88/048). NTIS, PC A03/MF A01.

The U.S. Environmental Protection Agency (EPA) has established a technology research, demonstration, and evaluation program to promote the use of innovative technologies for the treatment and destruction of hazardous-waste materials. In response to the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Office of Research and Development (ORD) and OSWER have established the Superfund Innovative Technology Evaluation (SITE) program to accelerate the development and use of alternative technologies at Superfund sites. The SITE program will provide assurance on performance data and cost information on those technologies.

31105 **(PB—88-185285/XAB) Technical guidance for corrective measures - subsurface gas.** (SCS Engineers, Inc., Reston, VA (USA)). 28 Mar 1985. 122p. NTIS, PC A06/MF A01.

This manual is intended to provide technical guidance for EPA and authorized State personnel in assessing the needs for corrective action reviewing permit applications, and writing permits for hazardous-waste facilities.

31106 **(PB—88-185723/XAB) Superfund Record of Decision (EPA Region 7): Minker/Stout/Romaine Creek - Stout Portion, Missouri (third remedial action), September 1987. Final report .** (Environmental Protection Agency, Washington, DC (USA)). 28 Sep 1987. 21p. (EPA/ROD/R—07-87/008). NTIS, PC A03/MF A01.

See also PB—85-214054.

The Stout portion of the Minker/Stout/Romaine Creek site is located on West Swaller Road near Imperial, Missouri, approxi-

mately 20 miles southwest of St. Louis. The Stout portion consists of five private properties, three of which have been purchased by EPA as part of a permanent relocation of area residents. In the late 1960s and early 1970s, southwest Missouri chemical plant producing 2,4,5-1 and hexachlorophene contracted a waste-oil reclaimer to remove process residues. These residues, contaminated with 2,3,7,8-tetrachlordibenzo-p-dioxin (TCDD), were mixed with waste oils and sprayed as a dust suppressant on a nearby horse arena. In March of 1983, the horse arena owner had the contaminated soils removed to various portions of the Minker/Stout/Romaine Creek site. Approximately 700 cubic yards of the soil was used as fill in the Stout area, near two mobile home pads. In 1982, EPA sampling revealed high concentrations of TCDD in onsite soils. Later that year, three of the five properties making up the Stout portion were purchased by EPA and the residents were permanently relocated. No removal of contaminated soil has been performed to date. The primary contaminant of concern is dioxin.

31107 **(PB—88-185798/XAB) Superfund Record of Decision (EPA Region 3): Kane and Lombard Site, Baltimore, Maryland (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 69p. (EPA/ROD/R—03-87/038). NTIS, PC A04/MF A01.

The Kane and Lombard site is an 8.4-acre parcel of undeveloped land in Baltimore, Maryland. Dumping and burning of construction debris, domestic trash, and drums occurred at the site from 1962 until 1967 when the city passed an ordinance prohibiting the open burning of refuse. Illegal dumping continued from 1967 until approximately 1984, during which time many citations were issued for illegal burning on the property. In 1980, Maryland State inspectors observed between 400 and 500 drums, the majority of which were rusted, damaged and contained holes. Following an onsite property assessment, EPA authorized the immediate removal of 1,163 drums in 1984. Of those, 822 drums were classified as empty and 341 drums contained contaminants which included: benzene, toluene, xylene, PAHs, PCBs, and heavy metals. Approximately six inches of soil below the drums were removed and disposed offsite. The site was stabilized by regrading, capping and revegetation. Currently, soil and ground water are contaminated with these prior drum contaminants.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 29922, 29951, 30185, 31277, 31926

31108 **(BR—82(10.149)) Habitat suitability index models: American eider (breeding).** Blumton, A.K.;Owen, R.B. Jr.;Krohn, W.B. (Maine Univ., Orono (USA). Maine Cooperative Fish and Wildlife Research Unit). Feb 1988. 33p. US Fish & Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88900477/JAW.

A review and synthesis of existing information was used to develop a model for evaluating the potential suitability of habitat along the coast of Maine for breeding American eider (Somateria mollissima dresseri). The model is scaled to produce an index from 0 (unsuitable habitat) to 1.0 (optimal habitat). Habitat suitability index models are designed for use with the Habitat Evaluation Procedures previously developed by the US Fish and Wildlife Service. Guidelines for model application are provided. 51 refs., 3 figs., 5 tabs.

31109 **(BR—82(10.150)) Habitat suitability index models: Black-bellied whistling-duck (breeding).** McKenzie, P.M.; Zwank, P.J. (Louisiana Cooperative Fish and Wildlife Research Unit, Baton Rouge (USA)). Feb 1988. 31p. U.S. Fish and Wildlife Serv., 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88900478/JAW.

A review and synthesis of existing information were used to develop a model for evaluating the quality of habitat for breeding black-bellied whistling-ducks. The model is scaled to produce an index between 0 (unsuitable habitat) and 1.0 (optimal habitat). Habitat suitability index models are designed for use with the Habitat Evaluation Procedures previously developed by the US Fish and Wildlife Service. Guidelines for model application and techniques for measuring model variable are provided. 58 refs., 1 fig., 5 tabs.

31110 **(BR—82(10.153)) Habitat suitability index models: Red king crab.** Jewett, S.C.; Onuf, C.P. (Alaska Univ., Fairbanks (USA). Alaska Cooperative Fishery Research Unit; National Wetlands Research Center, Slidell, LA (USA)). Mar 1988. 44p. US Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88900476/JAW.

A review and synthesis of existing information were used to develop models for evaluating habitat of different life stages of red king crab. The model is scaled to produce an index between 0 (unsuitable habitat) and 1 (optimal habitat) in Alaskan coastal waters, especially in the Gulf of Alaska and the southeastern Bering Sea. Habitat suitability models are designed for use with the Habitat Evaluation Procedures previously developed by the US Fish and Wildlife Service. Guidelines for model application and techniques for measuring model variables are provided. 94 refs., 1 fig., 7 tabs.

31111 **(PNL—6279-Vol.7) Hanford Meteorological Station computer codes: Volume 7, The RIVER computer code.** Andrews, G.L.; Buck, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 35p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007626/JAW.

The RIVER computer code is used to archive Columbia River data measured at the 100N reactor. The data are recorded every other hour starting at 0100 Pacific Standard Time (12 observations in a day), and consists of river elevation, temperature, and flow rate. The program prompts the user for river data by using a data entry form. After the data have been enetered and verified, the program appends each hour of river data to the end of each corresponding surface observation record for the current day. The appended data are then stored in the current month's surface observation file.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29918, 29919, 29920, 29921, 29950, 30031, 30085, 30086, 30087, 30146, 30148, 30410, 30411, 30911, 30991, 31050, 31064, 31087, 31088, 31214

31112 **(AD-A—189358/5/XAB) Economic evaluation of carbon adsorption/ion exchange wastewater-treatment options for Sunflower AAP (Army Ammunition Plant) NQ (nitroguanidine) wastewater-treatment facility. Final report, October 1986-July 1987.** Balasco, A.A.; Cheng, G.C.; Field, E.L.; Vejins, V.R. (Little (Arthur D.), Inc., Cambridge, MA (USA)). 31 Jul 1987. 71p. (ADL-REF—54144). NTIS, PC A04/MF A01.

The objective of this subtask was to provide an estimate of the capital investment and operating costs for the wastewater-treatment technology option involving activated-carbon adsorption and ion exchange for primary separation, and multiple-effect evaporation and spray drying for volume reduction. During the course of this study, however, it became evident that the process economics could be significantly improved of the ion-exchange step was eliminated from the process scheme. The bases for the system design, plant operation, and cost evaluation were provided to Arthur D. Little by Sunflower AAP personnel to make certain that direct comparisons could be made with other treatment options under consideration.

31113 **(DOE/FC/10120—2550-Vol.2) The effects of fly ash and flue-gas desulfurization wastes on groundwater quality in a reclaimed lignite strip mine disposal site: Volume 2, Appendices: Final report.** Beaver, F.W.; Groenewold, G.H.; Manz, O.E.; Hassett, D.J. (North Dakota Univ., Grand Forks (USA). North Dakota Mining and Mineral Resources Research Inst.). Aug 1987. Contract AK18-80FC10120;AT18-80FC10230;AT18-83FC10612. 606p.

Data on a disposal site for flyash waste and lue-gas desulfurization wastes are presented. Included are data on hydraulic conductivity, groundwater quality analyses from piezometers and lysimeters, stratigraphic position of the piezometers and lysimeters, interstitial water chemical analyses, hydrographs of the piezometer water levels, and water level data. (CBS)

31114 **(DPST—88-314) Initial evaluation of photographic data of F- and H-Area seepage basin outcrops.** Mackey, H.E. Jr. (Savannah River Lab., Aiken, SC (USA)). 08 Feb 1988. Contract AC09-76SR00001. 8p.

Photographic data for the Savannah River Plant (SRP) were reviewed for 1961 through 1987 to determine the value of this photography in estimating the timing and extent of the F- and H-Area seepage basin outcrops along the upper Four Mile Creek floodplain. In excess of 15,000 frames of photography of the SRP were reviewed. The quality of the photography varied widely and included panchromatic (black and white), natural color, and false color infrared. Altitudes of the photography ranged from 2,000 feet above ground level (AGL) to 40,000 feet AGL. For each year the best photography at the lowest altitude was evaluated to determine the presence of vegetation damage downslope of the F- and H-Area seepage basins. Criteria of no visible evidence of vegetation (forest canopy) damage, initial evidence of vegetation or canopy damage, canopy thinning, tree mortality, and expansion of vegtation damage and/or tree mortality zones were applied to each of the photographs. In this initial evaluation, only the largest of the outcrops below the seepage basins were evaluated. (3 tabs.)

31115 **(PB—88-170543/XAB) Microbial ecology of a shallow unconfined ground-water aquifer polluted by municipal-landfill leachate.** Beeman, R.E.; Suflita, J.M. (Oklahoma Univ., Norman (USA). Dept. of Botany and Microbiology). 1987. 18p. NTIS, PC A03/MF A01.

Pub. in Microbial Ecology, Vol. 14, No. 1, 39-54(Jul 1987).

The microflora of a shallow anoxic aquifer underlying a municipal landfill in Oklahoma was characterized by direct light microscopy, most probable number of determinations of sulfate reducers and methanogens, and measurements of methanogenesis in aquifer samples containing either endogenous or exogenous electron donors and various sulfate concentrations. Acridine orange direct counts of bacteria did not vary significantly with time or between 2 major sampling areas. A mapping of sulfate and methane levels indicated that site A is relatively localized. These results suggest that the predominant flow of carbon and energy is through methanogenesis at aquifer site B whereas sulfate reduction predominated at site A. However, both methanogens and sulfate reducers could be isolated from either site.

31116 **(PB—88-170733/XAB) Modeling volatile organics in the Delaware estuary.** Ambrose, R.B. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). 1987. 21p. (EPA—600/J-87/199). NTIS, PC A03/MF A01.

Pub. in Jnl. of Environmental Engineering 113, No. 4, 703-721(Aug 1987).

This study was conducted to test whether calibrated tidal-transport models linked to chemical-process submodels can be applied to aquatic-pollution problems using literature values for chemical properties. The chemical transport-and-fate model TOXIWASP is linked with the hydrodynamic model DYNHYD to calculate the upstream migration of seven volatile organic chemicals from a waste-water effluent to a drinking-water treatment plant in Philadelphia PA. Four steps of data acquisition and simulation are described: (1) hydrodynamics; (2) mass transport; (3) sediment transport; and, (4) chemical transport and transformation. Graphs and statistics indicate good agreement between simulation results and observed concentrations. Confidence intervals about the predictions generally envelop observed ranges. Effluent concentration estimates provide the largest source of uncertainty. Existing transport models may be adequate but could be improved with refinement and recalibration.

31117 **(PB—88-171426/XAB) Municipal wastewater-treatment technology-transfer activities of the United States Environmental Protection Agency.** Convery, J.J.; Kreissl, J.F.; Venosa, A.D.; Bender, J.H.; Lussier, D. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Feb 1988. 18p. (EPA—600/D-88/032). NTIS, PC A03/MF A01.

Technology transfer is an important activity within the U.S. Environmental Protection Agency. Specific technology-transfer programs, such as the activities of the Center for Environmental Research Information, the Innovative and Alternative Technology Program, as well as the Small Community Outreach Program, are used to encourage the utilization of cost-effective municipal pollution-control technology. Case studies of three technologies, including a plant-operations diagnostic/remediation methodology, alternative sewer technologies and ultraviolet disinfection, are presented. These case studies are presented retrospectively in the context of a generalized concept of how technology flows from science to utilization which was developed in a study by Allen (1977). Additional insights from the study are presented and the information gathering characteristics of engineers and scientists, which may be useful in designing technology-transfer programs. The recognition of the need for a technology or a deficiency in current practice are important stimuli other than technology transfer for accelerating the utilization of new technology.

31118 **(PB—88-176342/XAB) Report to the Congress on ocean pollution, monitoring, and research, October 1985 through September 1986.** (National Ocean Service, Rockville, MD (USA)). Dec 1987. 83p. NTIS, PC A05/MF A01.

See also report dated May 86, PB—87-129425.

Contents include: The NOAA program; Interagency coordination and dissemination of information; Strategic assessments branch; (Regional data atlases of the exclusive economic zone, Living marine resources, National estuarine inventory, National coastal pollutant discharge inventory, Economic survey of outdoor marine recreation in the USA); Coastal and estuarine assessments; (National status and trends program, Quality assurance, Consequences of contaminants); Hazardous materials response; Selected publications and information exchange; and International ocean disposal symposia; Program management.

31119 **(PB—88-180112/XAB) Control of volatile organic contaminants in groundwater by in-well aeration. Final report, February 1982-February 1986.** Miltner, R.J.; Coyle, J.A.; Borchers, H.J. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1988. 122p. (EPA—600/2-88/020). NTIS, PC A06/MF A01.

At a 0.1 mgd well contaminated with several volatile organic compounds (VOCs), principally trichloroethylene (TCE), several in-well aeration schemes were evaluated as control technologies. The well was logged by the USGS to define possible zones of VOC entry. A straddle packer and pump apparatus were utilized to isolate those zones and define their yield and level of VOC concentration. The technical literature together with this knowledge of the well were used to design an air-lift pump. Operation of the air-lift pump confirmed literature prediction of its low wire-to-water efficiency. Removal of TCE did not exceed 65%. Mass transfer occurred in the pump's eductor. Air-lift pumping coupled with in-well diffused aeration increased TCE removal to 78%. When in-well diffused aeration was used with an electric submersible pump, TCE removal averaged 83%. In the latter two schemes, mass transfer occurred utilizing the well as a countercurrent stripper. These technologies are limited by the volume of air that can be transferred to the well (air-to-water ratios below 12:1) and the cost of compressing air under high head. Thus, these technologies are not cost-effective compared to packed-tower aeration. They are, however, quickly put on-line, easy to operate, and can serve as good short-term remedies while above-ground technologies are under design and construction.

31120 **(PB—88-180153/XAB) Assimilative capabilities of retention ponds. Final report.** Martin, E.H.; Smoot, J.L. (Geological Survey, Tallahassee, FL (USA)). Apr 1986. 83p. NTIS, PC A05/MF A01.

The efficiency of a detention-pond and wetlands temporary storage system to reduce constituents loads in urban runoff was determined. The reduction efficiencies for 22 constituents, including the dissolved, suspended, and total phases of many of the constituents were investigated. A new method not previously discussed in technical literature was developed to determine the efficiency of a temporary storage-system unit such as a detention pond or wetlands. The method provides an efficiency, called the regression efficiency, determined by a regression made of loads-in against loads-out of a unit with the intercept of the regression constrained to zero. The regression efficiency of the treatment unit is defined as unity minus the regression slope. The system (pond and wetlands) achieved appreciable reductions of loads for most constituents.

31121 **(PB—88-180344/XAB) Degradation of selected halogenated ethanes in anoxic sediment-water systems.** Jafvert, C.T.; Wolfe, N.L. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). 1987. 13p. (EPA—600/J-87/273). NTIS, PC A03/MF A01.

Pub. in Environmental Toxicology and Chemistry, Vol. 6, No. 11, 827-837(Nov 1987).

The degradation of selected halogenated ethanes was studied in anoxic sediment-water suspensions at 1 to 20% sediment concentrations. Batch kinetic experiments were used to quantify decay. Eh measurements of all suspensions were below -100mV (vs SHE), indicating reduced environmental conditions. Hexachloroethane (HCA), 1,1,2,2-tetrachloroethane (TTCA), 1,2-diiodoethane (DIA) and 1,2-dibromoethane (DBA) were degraded within minutes to days, but 1,2-dichloroethane (DCA) remained in the system through 35 d, at which point the study was ended. The major route of transformation of these compounds in the system was vicinal dehalogenation. Rates of disappearance followed pseudo-first-order kinetics at low reactant concentrations and high sediment concentration.

31122 **(PB—88-180351/XAB) Aeration equipment evaluation. Phase 1. Clean water test results. Final report, 15 February 1978-16 March 1979.** Yunt, F.W.; Hancuff, T.O. (Los Angeles County Sanitation Districts, CA (USA)). Mar 1988. 203p. NTIS, PC A10/MF A01.

The research project was initiated with the principal objective of evaluating the oxygen-transfer perfomance of various generic aeration systems used in activated-sludge wastewater treatment. A secondary objective of the project was to evaluate various oxygen transfer data analysis methods in current use. Results of the work indicated that, of the systems tested, fine-bubble diffusion equipment transferred oxygen most efficiently in clean water. Results also indicated that, in clean water, jet aeration equipment transfers oxygen more efficiently than do coarse-bubble aeration systems. However, because the value of wastewater correction factors (alpha and beta) are dependent on the type of aerator tested, the relative performance of the aerators to one another in wastewater may be different.

31123 **(PB—88-180872/XAB) Chemical and biological survey of lakes and streams located in the Emerald Lake watershed, Sequoia National Park. Final report, July 1984-July 1986.** Melack, J.M.; Cooper, S.D.; Holmes, R.W.; Sickman, J.O.; Kratz, K. (California Univ., Santa Barbara (USA)). 18 Feb 1987. 374p. NTIS, PC A16/MF A01.

To investigate the effects or potential effects of acidification on Sierran aquatic habitats, the authors are conducting research on Emerald Lake and its inlet and outlet streams, in Sequoia National Park, California. Emerald Lake was chosen as the focus of the authors studies because it is representative of subalpine and alpine waters in the Sierra Nevada, and is located in the southwestern Sierra where acidic inputs are likely to be greater than in other areas of the Sierra Nevada. The investigations consist of two approaches: (1) A chemical and biological monitoring program and sediment analyses to provide the time series needed to distinguish the effects of anthropogenic disturbance from natural variation; and (2) experimental investigations to examine the sensitivity of aquatic communities to acidic inputs and to predict the responses of aquatic communities to increased acidification. The research reported here began in June 1984 and continued through July 1986.

31124 **(PB—88-182118/XAB) Removing synthetic organic chemicals from drinking water by granular activated carbon: performance and cost.** Lykins, B.W.; Clark, R.M.; Adams, J.Q. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1988. 12p. (EPA—600/D-88/046). NTIS, PC A03/MF A01.

GAC has been shown to be an effective adsorbent for removing many of the SOCs scheduled for regulation and to be an effective broad-spectrum adsorbent. U.S. EPA data presented in the paper demonstrates by field-scale contactors, pilot-columns, and minicolumns the adsorbability of many SOCs. In DWRD laboratories, isotherm, microcolumn, and pilot column studies are underway on others. The extent of SOC removal depends on several factors such as EBCT, type of GAC used, competition for adsorption sites from other organics, precursor material, etc. Each utility considering GAC for SOC control should evaluate their specific situation. The evaluation should include some method for predicting full-scale operation.

31125 **(PB—88-182654/XAB) Survey of sensitivity of southern California lakes to acid deposition. Final report, 1985-1986.** Melack, J.M.; Setaro, F. (California Univ., Santa Barbara (USA)). 30 Sep 1986. 82p. NTIS, PC A05/MF A01.

During 1985-86 solute composition of 23 California lakes and ponds was determined. The strategy was to sample the same waters during the autumn and under ice or soon after ice out and to evaluate the necessity of sampling at multiple stations and from more than one depth. Chemical parameters measured included pH, alkalinity, conductance, major cations (calcium, magnesium, sodium, and potassium), major anions (nitrate, sulfate, chloride), silica, nutrients (ammonium and phosphate), total and total dissolved nitrogen and phosphorus, and total and dissolved levels of aluminum, iron, and manganese. Coastal ponds and low-elevation lakes exhibited circumneutral to alkaline pH, high alkalinity and high levels of dissolved ions.

31126 **(PB—88-184023/XAB) Design manual: municipal wastewater stabilization ponds.** Middlebrooks, E.J.; Reynolds, J.H.; Montgomery, J.M.; Middlebrooks, C.; Schneiter, R.W. (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Oct 1983. 343p. (EPA—625/1-83/015). NTIS, PC A15/MF A01.

The manual provides a concise overview of wastewater stabilization pond systems through discussion of factors affecting treatment, process design principles and applications, aspects of physical design and construction, suspended solids removal alternatives, and cost and energy requirements.

31127 **(PB—88-184825/XAB) Preliminary environmental assessment of the contamination associated with Lake Calumet, Cook County, Illinois.** Ross, P.E.; Henebry, M.S.; Risatti, J.B.; Murphy, T.J.; Demissie, M. (Illinois Inst. of Natural Resources, Champaign (USA). Illinois Natural History Survey). Feb 1988. 150p. NTIS, PC A07/MF A01.

This report details the results of a multidisciplinary study to determine the level of contamination of Lake Calumet in Cook County, Illinois. The study was initiated to evaluate the physical, chemical and biological processes that influence the environmental quality of the lake and the surrounding area and to predict the ecological effects of the contamination associated with lake sediments. Some principal findings of the study include: (1) concentrations of toxic metals are above background levels and higher in the lake than in nearby water bodies; (2) all sediment-sampling stations produced toxic responses in single-species bioassays, with over half the stations classified as highly toxic; and (3) community-level bioassays showed toxic effects at 71% of sampling stations.

31128 **(PB—88-184833/XAB) Assessment of the ecotoxicological hazard of sediments in Waukegan Harbor, Illinois.** Ross, P.; Henebry, M.; Burnett, L.; Wang, W. (Illinois Inst. of Natural Resources, Champaign (USA). Illinois Natural History Survey). Jan 1988. 76p. NTIS, PC A05/MF A01.

Between 1948 and 1971, Waukegan Harbor, Illinois received large inputs of PCBs (polychlorinated biphenyls), much of which remain in harbor sediments. To evaluate the environmental hazard of these sediments, 24 samples from throughout the harbor were examined in the study for PCB concentrations and acute invertebrate, community, and plant toxicity. Total PCB concentrations in sediment samples were in substantial agreement with the ranges reported in previous studies. All but three stations had concentrations above the safe (10 mg/kg) level previously recommended.

31129 **(PB—88-185608/XAB) Computer-aided design of diffused aeration systems. Report for January-March 1988.** Rossman, L.A.; Heidman, J.A. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1988. 12p. (EPA—600/D-88/056). NTIS, PC A03/MF A01.

CADDAS (Computer Aided Design of Diffused Aeration Systems) is a microcomputer-based program that analyzes the cost and performance of diffused aeration used in activated sludge wastewater-treatment systems. The program can analyze both coarse-bubble and fine-pore diffusers as well as detailed blower configurations and operational strategies. For a given set of hourly oxygen demands throughout the year, diffuser performance characteristics, and blower capacity/operational capability, CADDAS computes hourly dissolved oxygen levels, air-flow requirements, and blower energy usage over each month of a multi-year planning period. Special attention is paid to the effects of fine pore diffuser fouling on oxygen transfer efficiency and its restoration through cleaning. CADDAS also computes the present-worth costs of initial equipment installation, monthly energy usage, annual routine maintenance, and periodic diffuser cleaning.

31130 **(PB—88-185616/XAB) Data-based water-quality information system.** Campbell, S.; Finkeldey, J. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1988. 14p. (EPA—600/D-88/055). NTIS, PC A03/MF A01.

Various research activities conducted by the Drinking Water Research Division of the U.S. EPA have resulted in the generation of extensive measurement data pertaining to water quality. The data are useful for investigating the performance and cost of drinking-water-treatment process systems. In order to perform multiple and/or extensive evaluations of this data, it was necessary to develop a computer-based information-retrieval system that would provide a consistent-input data format and the capability to manage, access, and report required information. The computer software resulting from this effort has provided DWRD with an effective method for analyzing large amounts of field-scale research data and providing ideas to upgrade water quality.

31131 **(PB—88-185921/XAB) Approach for development of structure-biodegradation relationships of organic chemicals.** Niemi, G.J.; Veith, G.D. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Mar 1988. 25p. (EPA—600/D-88/047). NTIS, PC A03/MF A01.

This study presents a strategy for evaluation of biodegradability of chemicals that involves a combination of structure-biodegradation relationships (SBR) and laboratory testing arranged in a four-tier hierarchy. The first tier involves a search of a data base on biodegradation information. Each subsequent tier consists of a query of potential SBR for the chemical or an experimental laboratory test of the chemical using a tier-specific procedure. The approach satisfies the critical need to develop a systematic reference data base on biodegradation endpoints for existing and new chemicals, incorporates the metabolites of biodegradation into the process, and provides an economical means to evaluate chemical biodegradation.

31132 **(PB—88-186101/XAB) Municipal waste-water sludge-combustion technology. Seminar pub.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Sep 1985. 190p. (EPA—625/4-85/015). NTIS, PC A09/MF A01.

See also PB—88-186119.

This publication describes and evaluates the various municipal sludge-combustion systems. It also emphasizes the necessity for considering and evaluating the costs involved in the total sludge-management train, including dewatering, combustion, air pollution control, and ash-disposal processes. It is intended to supplement but not replace EPA technology-transfer publications on sludge treatment and disposal, dewatering municipal wastewater sludges, municipal sludge landfills, and land application of municipal sludge. It also answers questions that have been raised about incineration as a means of processing sludge solids for ultimate disposal and presents factual answers supported by case histories. The primary objectives of the document are: (1) to assess the current status of municipal-sludge-combustion technology as to performance of in-place systems, environmental concerns, and regulatory agency viewpoints; (2) to determine what needs to be done to make municipal-sludge combustion more economical, including upgrading the performance of present and future systems; and (3) to discuss technology in the R and D stage.

31133 **(PB—88-186119/XAB) Composting of municipal waste-water sludges. Seminar pub.** (Environmental Protection Agency, Cincinnati, OH (USA). Center for Environmental Research Information). Aug 1985. 75p. (EPA—625/4-85/014). NTIS, PC A04/MF A01.

See also PB—88-186101.

This seminar publication provides practical information on current methods of composting municipal waste-water sludges. It is intended for government and private sector individuals involved in the planning, design, and operation of municipal sludge treatment and disposal systems. Chapter 1 presents general principles of the composting process and system design. Chapters 2 and 3 discuss in depth the experiences at the Dickerson, Western Branch, and Site II static-pile-composting operations in Maryland and at the windrow operation in Los Angeles County. In-vessel composting is reviewed in Chapter 4. Chapter 5 discusses current and proposed regulations and guidelines that pertain to sludge composting. The publication is not a design manual nor does it include all the latest knowledge about composting.

31134 **(PB—88-860747/XAB) Sediment-water interactions and their effects upon water quality. January 1979-March 1988 (citations from the NTIS data base). Report for January 1979-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 85p. NTIS PC N01/MF N01.

Supersedes PB—87-855912.

This bibliography contains citations concerning contaminant transport and fate in hydraulic systems containing sediments. Topics include nutrient recycling, absorption, and desorption of a variety of contaminants, ion-exchange processes, and the utilization of transport models in contamination studies. Citations pertaining specifically to marine environments are excluded. (This updated bibliography contains 147 citations, 12 of which are new entries to the previous edition.)

31135 **(PB—88-861315/XAB) Sewage effects in marine and estuarine environments. January 1977-March 1988 (citations from the NTIS data base). Report for January 1977-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 154p. NTIS PC N01/MF N01.

Supersedes PB—87-851564.

This bibliography contains citations concerning the effects of disposal of sewage effluents and sludge on marine and estuarine environments. The effects on specific flora and fauna, ocean dumping problems, and pollutant distribution analyses are among the topics considered. Regional and site specific studies regarding environmental effects of ocean waste disposal are presented. (This updated bibliography contains 309 citations, 54 of which are new entries to the previous edition.)

31136 **(SAND—88-0226C) A comparison of laboratory performances.** Einerson, J.H.;Pei, P.C. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 56p. (CONF-880357—1). NTIS, PC A; 04/MF A01; GPO Dep. Order Number DE88006660/JAW.

From New Mexico Hazardous Waste Management Society; Albuquerque, NM, USA (17 Mar 1988).

This study was initiated to select reliable, competent laboratories which could perform analyses of wastewater contaminants for the purpose of regulatory compliance. Ten laboratories were selected to participate in the competency tests. In addition to reviews of quality assurance plans, the laboratories were given check samples to test the accuracy and precision of their analytical techniques. The check samples were spiked with seven inorganic contaminants commonly found in wastewater discharges;these samples were sent along with other routine wastewater samples. Each of the laboratories was sent a letter which accompanied the samples specifying handling instructions. This paper describes the procedures which are helpful in identifying those laboratories that provide precise and accurate analytical services on a consistent basis. The laboratories' qualifications were based on six criteria: ability to customize reports, turnaround time, cost, precision and accuracy from the analyses of check samples, and evaluation of quality assurance documents. Each laboratory was scored and ranked by criteria;the overall scores produced a list of laboratories ranked in order of competence. 9 refs., 11 tabs.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 30016, 30085, 30086, 30087, 30145, 30146, 30148, 31076, 31077, 31376

31137 **(AERE-G—4347) Uranium series disequilibrium measurements at Mol, Belgium and Whiteshell. Final combined report.** Ivanovich, M.; Wilkins, M.A. (UKAEA Harwell Lab. Nuclear Physics Div.; Department of the Environment, London (UK)). Jul 1987. 26p. (DOE-RW—87.114). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753084/JAW.

Measurements of uranium series disequilibrium in groundwaters derived from sand layers above and below the Boom Clay formation in North East Belgium, are analysed in terms of uranium, thorium and radium isotopic geochemistries, water types, and their mixing in the regional groundwater systems. Most sampled waters are mixtures of younger shallow groundwaters from horizons above the Boom Clay lens and older waters from horizons below the lens, at depths greater than 500m. No true old water end-members have been sampled. The longest residence times of the sampled waters are found to be not much in excess of 10^4y. More detailed modelling is required in conjunction with groundwater hydraulic pressure and flow direction data to establish detailed mixing patterns. In a second parallel study the $^{228}Ra/^{226}Ra$ activity ratios were measured in large groundwater samples, from the Underground Research Laboratory at Pinawa, Canada.

31138 **(AERE-R—12086) Studies of environmental radioactivity in Cumbria, Part 9. Physical characteristics of colloids and particulates in coastal sediments and seawater.** Ramsay, J.D.F.; Raw, G. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Oct 1987. 28p. (DOE-RW—87.066). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753086/JAW.

The physical characteristics and actinide adsorption behaviour of colloids and fine particulates in Cumbrian coastal sediments and seawater have been determined to assess the role of particles in the sea to land transfer of actinides in seaspray. Procedures have been developed for the separation of particulates into different size and mineral fractions using deflocculation and sedimentation under gravity and centrifugally. These fractions have been characterised using a range of physicochemical techniques. Specific activities of actinides (Pu, Am) adsorbed on these fractions have been correlated with size and mineral composition. Tentative evidence of the role of the fine particulates in sea to land transfer is discussed.

31139 **(CEA-R—5409) Radio-ecological study of the Lodeve mining complex (France) 1981-1985.** Descamps, B. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). Nov 1987. 102p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753061/JAW.

The radio-ecological study of the Lodeve mining complex (mine + uranium process plant) was carried out between 1981 and 1985. Four aquatic compartments -water, sediments, vegetals, fish- were studied in eight stations selected on the basis of the existence of two liquid wastes. The measurements essentially concerned radium 226 and uranium 238 but also lead 210 (1985), thorium 232, potassium 40 and cesium 137. Spectrometry γ Ge-Li, emanometry and fluorimetry were used. Only a small brook -Rivernoux- an affluent of the Lergue river, shows radium and uranium activity levels higher than those measured upstream of the site; and this for the four compartments. In water, radium is associated with the solved cationic fraction (66%) and with materials in suspension (21%), whereas uranium is essentially associated with the solved anionic fraction (84%); the radium migration potentialities are therefore lesser than that of uranium. Radium distribution in fish is as follows: flesh (5 to 15%), skeleton (12%), viscera (30%) and skin + fins (30%). Radium concentration (or exchange) factors are always higher than those corresponding to uranium. In general, they are more important in non-influenced zones than in influenced zones (Rivernoux); this implies that radium and uranium evacuated by the mining complex are, at least partly, in non bio-available forms. For waterfish exchange a concentration factor of 100 will be considered for radium. On the basis of this value a weekly consumption of 200 g of fried gudgeon gives an annual committed dose equivalent corresponding to 0.86% of the dose authorized for the public (5.10^{-3} Sv.an^{-1}).

31140 **(FLPU—86-8) Influences of sulphate reducing bacteria on ^{137}Cs sorption and their tolerances in nutrient depleted natural materials - a preliminary study.** West, J.M.; Abbott, M.A.W.; Rowe, E.J. (British Geological Survey, Keyworth. Fluid Processes Research Group; Department of the Environment, London (UK)). 1986. 85p. (DOE-RW—87.087). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752749/JAW.

Two sulphate reducing bacteria (SRB) isolates have been tested to determine their effect on the behaviour of radionuclides in Fullers Earth (Ca montmorillonite) groundwater. Experiments to determine microbial numbers/activity in the Fullers Earth groundwater under extreme environmental conditions have also been carried out. Other water/solid materials have also been analysed for nutrient content. Results show that the presence of SRB in sorption experiments lowers the distribution coefficients. The magnitude of these results will depend on the numbers and probably the activity of the microbes in the transporting groundwaters. Tolerance tests show that the microbes can survive extreme environments in nutrient depleted environments but that their growth will be limited by nutrient availability. Phosphorus is the least available nutrient in all the materials analysed for nutrient content.

31141 **(SKI—85119) Uncertainty analysis of hydrology calculations for final repositories for nuclear waste. Phase I.** Gustafsson, B. (Swedish Nuclear Power Inspectorate, Stockholm). 18 Jun 1986. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753024/JAW.

The technique of using the NAMMU-HYPAC computer code has been transferred from the group of developers to an end user. The package has been found to be flexible and powerful but also quite demanding. The code has been used to investigate certain numerical properties of hydrological models including variations of permeability.

31142 **(UCRL—53846) Radionuclide concentrations in fish and invertebrates from Bikini Atoll.** Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Jokela, T.A.; Brunk, J.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 55p.

As in other global studies, $_{137}Cs$ was found in the highest concentrations in edible flesh of all species of fish and in the lowest

concentrations in the bone or liver. The mean concentration of ^{137}Cs in muscle of reef fish from the southern part of the atoll is comparable to the global-fallout concentration measured in market samples of fish collected from Chicago, IL, USA, in 1982. Strontium-90 is associated generally with non-edible parts of fish, such as bone or viscera. Twenty-five to fifty percent of the total body burden of ^{60}Co is accumulated in the muscle tissue; the remainder is distributed among the liver, skin, and viscera. The mean concentration of ^{60}Co in fish has been decreasing at a rate faster than radiological decay alone. Most striking is the range of ^{207}Bi concentrations among different species of fish collected at the same time and place. Highest concentrations of ^{207}Bi were consistently detected in the muscle and other tissues of goatfish and some of the pelagic lagoon fish. In other reef fish, such as mullet, surgeonfish, and parrotfish, ^{207}Bi was usually below detection limits by gamma spectrometry. Over 70% of the whole-body activity of ^{207}Bi in goatfish is associated with the muscle tissue, whereas less than 5% is found in the muscle of mullet and surgeonfish. Neither $^{239+240}Pu$ nor ^{241}Am is accumulated significantly in the muscle tissue of any species of fish. Apparently, ^{238}Pu is in a more readily available form for accumulation by fishes than $^{239+240}Pu$. Based on a daily ingestion rate of 200 g of fish flesh, dose rates to individuals through the fish-food ingestion pathway are well below current Federal guidelines. 24 refs., 1 fig., 27 tabs.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 30186, 30221, 30323

31143 (DOE/BP—906) Oregon final summary report for the Pacific Northwest Rivers Study. (Oregon State Dept. of Energy, Salem (USA)). Nov 1987. 104p.

The study identifies resource values that might affect hydropower development. To achieve this, the study produced a consistent and comprehensive river resource data base. The data can show areas where there should be minimal development impact. This report shows the kinds of data that are available from the study. The study evaluates river segments for: resident fish, wildlife, natural features, recreation, historic features, archeological features, and legal constraints. For each resource category, the terms outstanding, substantial, moderate, limited unclassified, and unknown denote relative values. We store data by computer for all values of a given stream segment. Central to this system is a stream coding system developed by the U.S. Environmental Protection Agency (EPA). By correlating EPA reach codes to each category, we canproduce a comprehensive data display for each stream segment. Some types of information cannot readily be linked to stream segments. They include historic and archeological sites and local, state, and federal legal constraints.

31144 (PB—88-177886/XAB) Standards and study guides of water resources systems. Manual for 1969-1986. Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 20 Jan 1987. 235p. (LIR—01-87/229). NTIS, PC A11/MF A01.

See also PB—88-177894.

The following five important documents are compiled as Standards and Study Guides of Water Resources Systems: (1) A Practical Guide to Water-Quality Studies of Streams; (2) Water-Quality Regulations--Surface Water and Groundwater Classifications and Standards; (3) Water-Quality Standards Comparison; (4) A Primer on Groundwater; (5) Glossary of Water Resource Terms.

31145 (SREL—32) Ecological studies related to construction of the Defense Waste Processing Facility on the Savannah River Plant: FY 1986 annual report. Scott, D.E.; Pechmann, J.H.K.; Knox, J.N.; Estes, R.A.; Dancewicz, A.M. (Savannah River Ecology Lab., Aiken, SC (USA). Div. of Stress and Wildlife Ecology). Dec 1986. Contract AC09-76SR00819. 117p.

This report provides data on the effect of construction on organisms inhabiting the Savannah River Plant. Five sections evaluate habitats and the status of individual species within the reservation. Each section comprise a separate paper. All five are processed separately for the data base. (TEM)

31146 (TR-EL—82-4-82/11-79) Pacific herring: Species profiles, life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest). Barnhart, R.A. (Humboldt State Univ., Arcata, CA (USA). California Cooperative Fishery Research Unit). Feb 1988. 21p.

Species profiles are literature summaries of the taxonomy, morphology, distribution, life history, and environmental requirements of coastal aquatic species. They are prepared to assist in environmental impact assessment. The Pacific herring, Clupea harengus pallasi, spawns in intertidal and subtidal waters of the Pacific coast during the winter-spring season. In California, female herring average about 220 eggs per gram body weight. Herring are fished commercially primarily during the spawning season to obtain herring roe for export to Japan. Herring have a significant ecological role; herring spawn deposits attract many predators, and the abundant herring larvae and juveniles found in estuaries and nearshore waters serve as food for larger sea life. Herring embryos and larvae are fairly plastic regarding temperature and salinity, and survival probably depends largely on extent of predation and food supply. Excessive turbidity hinders the spawning and incubation of herring. Herring embryos, larvae, and juveniles are subject to various pollutants introduced into the estuarine environment. 60 refs., 4 figs.

5206 Regulations

REFER ALSO TO CITATION(S) 30412, 31082, 31098, 31099, 31100, 31101, 31102, 31103, 31104, 31106, 31107, 31144

31147 (PB—88-170592/XAB) Hazardous-waste site management: water-quality issues. Report on a colloquium sponsored by the Water Science and Technology Board, February 19-20, 1987. Colloquium 3. Barth, E.F.; Brown, H.S.; Davidson, J.M.; Dowd, R.M.; Easu, R.R. (National Research Council, Washington, DC (USA). Water Science and Technology Board). 21 Jan 1988. 222p. NTIS, PC A10/MF A01.

See also PB—86-201233 and PB—87-157467; Library of Congress catalog card No. 87-31311.

The report, a collection of papers from a colloquium sponsored by the Water Science and Technology (WSTB), discusses ground and surface-water cleanup levels at hazardous-waste sites and evaluates whether the scientific, technical, and regulatory methods currently used for setting cleanup levels are adequate. It addresses current methods used by regulatory agencies and the U.S. Department of Defense to establish water-quality cleanup levels, and provides insight from representatives of water utilities, industry, regulatory agencies, and citizens groups. The report also reviews the use of models and other methods for estimating health risks at hazardous-waste sites, and looks at the roles of hydrogeology, engineering, risk assessment, and toxicology, and regulatory strategies in hazardous-waste-site management.

31148 (PB—88-171269/XAB) Health and environmental effects profile for acrolein. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 124p. (EPA—600/X-85/369). NTIS, PC A06/MF A01.

The Health and Environmental Effects Profile for acrolein was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Acrolein was determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for acrolein is 1.09 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000,

or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for acrolein is 10.

31149 **(PB—88-172127/XAB) Superfund Record of Decision (EPA Region 2): Diamond Shamrock Site, Newark, New Jersey (remedial alternative selection), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 20 Sep 1987. 209p. (EPA/ROD/R—02-87/053). NTIS, PC A10/MF A01.

Contents include: background chronology; scope of this record of decision; site location and description; remedial investigation findings; risks presented by the site; the criteria for remedy selection; description and evaluation of remedial alternatives; cleanup standards; description of the selected alternative; enforcement; community relations; and glossary of terms and acronyms.

31150 **(PB—88-172135/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium Site, 12th and quivas properties, Colorado (selected remedial action), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 43p. (EPA/ROD/R—08-87/013). NTIS, PC A03/MF A01.

See also PB—88-172176, and PB—88-126461; Portions of this document are not fully legible.

This decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 12th and Quivas properties, Operable Unit I of the Denver Radium Site. The attached index identifies the items that comprise the administrative record upon which the selection of the remedial action was based.

31151 **(PB—88-172143/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium Site, 1000 West Louisiana properties, Colorado (selected remedial action), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 44p. (EPA/ROD/R—08-87/017). NTIS, PC A03/MF A01.

See also PB—88-172135; Portions of this document are not fully legible.

This decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 1000 West Louisiana properties, Operable Unit III of the Denver Radium Site. The attached index identifies the items that comprise the administrative record upon which the selection of the remedial action was based.

31152 **(PB—88-172168/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium Site, 11th and Umatilla properties, Colorado (selected remedial action), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 46p. (EPA/ROD/R—08-87/015). NTIS, PC A03/MF A01.

See also PB—88-172143; Portions of this document are not fully legible.

This decision document presents the selected remedial action for the operable unit of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the 11th and Umatilla properties, Operable Unit II of the Denver Radium Site. The attached index identifies the items that comprise the administrative record upon which the selection of the remedial action was based.

31153 **(PB—88-172176/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium Site, Open Space properties, Colorado (selected remedial action), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 61p. (EPA/ROD/R—08-87/014). NTIS, PC A04/MF A01.

See also PB—88-172168; Portions of this document are not fully legible.

This decision document presents the selected remedial actions for the properties included in Operable Units VI, IX, and XI of the Denver Radium Site developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Contingency Plan (40 CFR Part 300). The decision is based upon the administrative record for the Open Space properties, Operable Units VI, IX, and XI of the Denver Radium Site. The attached index identifies the items that comprise the administrative record upon which the selection of the remedial actions was based.

31154 **(PB—88-172184/XAB) Superfund Record of Decision (EPA Region 7): Conservation Chemical Company site, Kansas City, Missouri (remedial alternative selection), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 74p. (EPA/ROD/R—07-87/009). NTIS, PC A04/MF A01.

Contents include: site location and description; site history; endangerment assessment; development of alternatives; detailed evaluation of alternatives; recommended alternative; applicable or relevant and appropriate requirements; schedule; community relations; enforcement analysis; and responsiveness summary.

31155 **(PB—88-172192/XAB) Superfund Record of Decision (EPA Region 6): Compass Industries Landfill site, Tulsa County, Oklahoma (remedial alternative selection), September 1987.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 72p. (EPA/ROD/R—06-87/025). NTIS, PC A04/MF A01.

Contents include: site location and description; enforcement; community-relations history; alternatives evaluation; and proposed remedy.

31156 **(PB—88-173596/XAB) Health and environmental effects profile for acetonitrile.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 77p. (EPA—600/X-85/357). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for acetonitrile was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates have been presented provided sufficient data are available. Acetonitrile has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for acetonitrile is 1.28 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for acetonitrile is 100.

31157 **(PB—88-173638/XAB) Health and environmental effects profile for dinitrobenzenes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 61p. (EPA—600/X-85/361). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for dinitrobenzenes was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates have been presented provided sufficient data are available. Dinitrobenzenes have been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for dinitrobenzenes is 0.028 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for dinitrobenzenes is 100.

31158 **(PB—88-173653/XAB) Health and environmental effects profile for dichloropropanes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 90p. (EPA—600/X-85/360). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for dichloropropanes was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates have been presented provided sufficient data are available. Dichloropropanes have been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for dichloropropanes is .0633 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for dichloropropanes is 1000.

31159 **(PB—88-174511/XAB) Health and environmental effects profile for lead alkyls.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1985. 97p. (EPA—600/X-85/285). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for lead alkyls was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates were presented, provided sufficient data are available. Lead alkyls have been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for lead alkyls is 0.0084 micrograms/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for lead alkyls is 10.

31160 **(PB—88-174529/XAB) Health and environmental effects profile for chloroethene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 176p. (EPA—600/X-85/374). NTIS, PC A09/MF A01.

The Health and Environmental Effects Profile for chloroethene was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates are presented, provided sufficient data are available. Chloroethene has been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for chloroethene is 1.9 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for chloroethene is 100.

31161 **(PB—88-174594/XAB) Health and environmental effects profile for 1,3-dichloropropene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1985. 95p. (EPA—600/X-85/399). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for 1,3-dichloropropene was prepared by the Office of Health and Environmental Assessment. Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates are presented, provided sufficient data are available. 1,3-Dichloropropene has been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for 1,3- dichloropropene is .174 (mg/kg/day)-2 for oral exposure. The Reportable Quantity (RO) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for 1,3-dichloropropene is 100.

31162 **(PB—88-174958/XAB) Health and environmental effects profile for formaldehyde.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Oct 1985. 154p. (EPA—600/X-85/362). NTIS, PC A08/MF A01.

The Health and Environmental Effects Profile for formaldehyde was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environ-

mental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for formaldehyde. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for formaldehyde is 10.

31163 (PB—88-174974/XAB) Health and environmental effects profile for aniline. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 119p. (EPA—600/X-85/356). NTIS, PC A06/MF A01.

The Health and Environmental Effects Profile for aniline was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinatti, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented provided sufficient data are available. Aniline has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for aniline is .026 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for aniline is 1000.

31164 (PB—88-174982/XAB) Health and environmental effects profile for azobenzene. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Mar 1985. 62p. (EPA—600/X-86/082). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for azobenzene was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Azobenzene has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for azobenzene is .108 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for azobenzene is 100.

31165 (PB—88-175039/XAB) Health and environmental effects profile for antimony oxides. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1985. 129p. (EPA—600/X-85/271). NTIS, PC A07/MF A01.

The Health and Environmental Effects Profile for antimony oxides was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health- related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented provided sufficient data are available. Antimony oxides have been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for antimony, antimony trioxide, antimony tetroxide, and antimony pentoxide is 24.5, 29.3, 30.9 and 32.5 micrograms/day, respectively, for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for antimony oxides is 100.

31166 (PB—88-176037/XAB) Health and environmental-effects profile for cresols. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 77p. (EPA—600/X-85/358). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for cresols was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates have been presented provided sufficient data are available. Cresols has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for cresols is 3.6 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for cresols is 100.

31167 (PB—88-177894/XAB) Standards and guides of wastewater treatment and sewer systems. Manual for 1969-1978. Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 15 Jan 1987. 319p. (LIR—01-87/227). NTIS, PC A14/MF A01.

See also PB—88-177902.

The following six important documents are compiled as Standards and Guides of Wastewater Treatment and Sewer Systems: (1) A Primer on Wastewater Treatment; (2) Recommended Standards for Sewage Works; (3) Design Handbook for Low Pressure Sewer System; (4) Low Pressure Sewers; (5) Clay Pipe Engineering Manual; (6) Siting and Design of Municipal Treatment Plants.

31168 (PB—88-177902/XAB) Standards and guides of water treatment and water-distribution systems. Manual for 1974-86. Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 15 Jan 1987. 349p. (LIR—01-87/226). NTIS, PC A15/MF A01.

See also PB—88-178058.

The following five important documents are compiled for design of municipal water treatment facilities and water distribution systems: (1) Ten States Recommended Standards for Water Works; (2) A Public Water Supply Guide--Designing Community Water Systems; (3) Water Supply Guide Lines for Public Water Systems; (4) American National Standard for the Thickness Design of Ductile-Iron Pipe; and (5) Designing for Cast Iron Pipe.

31169 **(PB—88-178058/XAB) Drinking water standards and regulations. Manual for 1977-1986.** Wang, L.K.; Wang, M.H.S. (Lenox Inst. for Research, Inc., MA (USA)). 15 Jan 1987. 243p. (LIR—01-87/228). NTIS, PC A11/MF A01.

See also PB—88-177886; Portions of this document are not fully legible.

The following eight important documents are compiled for Drinking Water Standards and Regulations: (1) EPA Interim Primary Drinking Water Standards; (2) EPA Guidelines establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; (3) Massachusetts Dept. of Environmental Quality Engineering, Interpretation of Results of Water Supply Analysis; (4) Thompson, J.C., Updating the Safe Drinking Water Act and the Drinking Water Regulations; (5) Lists of Acceptable Drinking Water Additives; (6) Title XIV of the Public Health Service Act (The Safe Drinking Water Act); (7) Standards for Quality of Public Drinking Water--Connecticut; (8) New York State Sanitary Code of Drinking Water Supplies (Including Drinking Water Standards).

31170 **(PB—88-185251/XAB) Corrective measures for releases to ground water from solid-waste-management units. Draft report (Final).** Gosse, M.M.; Farrell, L.L.; Prominski, N.; Arienti, M.; Dwight, D. (Alliance Technologies Corp., Bedford, MA (USA)). Aug 1985. 168p. (GCA-TR—85-69-G). NTIS, PC A08/MF A01.

The Hazardous and Solid Waste Act (HSWA) of 1984 requires corrective measures for all releases of hazardous waste or hazardous constituents from any solid-waste-management unit at a treatment, storage, or disposal facility seeking a RCRA permit, regardless of the time at which waste was placed in such unit. In the report, ground-water control/treatment technologies at hydrogeologic settings are identified and assessed.

31171 **(PB—88-185731/XAB) Superfund Record of Decision (EPA Region 5): Northern Engraving Corporation, Sparta, Wisconsin (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 28 Sep 1987. 63p. (EPA/ROD/R—05-87/057). NTIS, PC A04/MF A01.

The Northern Engraving Corporation (NEC), located in Sparta, Wisconsin, presently owns and operates a manufacturing facility at the site, which produces metal name plates, dials, and decorative trim for the automotive industry. The majority of the land within the Sparta area is zoned for general agriculture which includes livestock raising, nursery, greenhouse and poultry farming. Four separate areas of contamination at the NEC facility have been identified as potential sources of soil, ground water and surface water contamination. They include the sludge lagoon, seepage pit, sludge dump site and lagoon drainage ditch. The chemical constituents found in these areas are from past wastewater treatment and disposal practices employed at the site. Since the 1960s waste rinse waters and by-products of the metal finishing process have been treated onsite. An onsite wastewater-treatment lagoon was installed in 1967. Rinse water from the plant was collected and treated with sodium hydroxide for precipitation to metal hydroxide solids. The treated rinse water was discharged to the sludge lagoon to allow solids to settle. The treated lagoon effluent was discharged to the LaCrosse River by way of a storm-drainage ditch.

31172 **(PB—88-185749/XAB) Superfund Record of Decision (EPA Region 4): Independent Nail Company, Beaufort, South Carolina (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 28 Sep 1987. 63p. (EPA/ROD/R—04-87/030). NTIS, PC A04/MF A01.

The Independent Nail Company site, occupying 24.6 acres, is located near Beaufort, South Carolina. Land use in the vicinity of the site is a combination of fields, woodlands, and wetlands. Endangered and threatened species may occur within the area of influence of the site, although habitation has not been confirmed. The previous owners of the site, the Blake and Johnson Company, manufactured metallic screws and fasteners. In part of the manufacturing process, the company discharged approximately 33,000 gallons per day of plating wastewater into an unlined infiltration lagoon. The lagoon was in use from approximately 1969 to 1980. The South Carolina Department of Health and Environmental Control (SCDHEC) reported that the wastewater contained some organic cleaning solvents, phosphate, cyanide, chromium, cadmium, lead, mercury, nickel, zinc, copper and iron. In April 1980 the Blake and Johnson Company ceased operation. Two months later the Independent Nail Company purchased the plant. They currently operate a paneling nail coating process at the plant, but do not discharge any wastewater to the lagoon. The primary contaminants of concern to the soil and sediment include: cadmium, chromium, nickel and zinc.

31173 **(PB—88-185756/XAB) Superfund Record of Decision (EPA Region 2): Katonah Municipal Well, Bedford, New York (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1987. 43p. (EPA/ROD/R—02-87/047). NTIS, PC A03/MF A01.

The Katonah Municipal Well site is located in the Village of Katonah in the Town of Bedford, Westchester County, New York. The well is situated on a peninsula owned by the City of New York that extends into the Muscoot Reservoir. In 1978 the Westchester County Department of Health (WCDH), acting on Putnam County Health Department findings, sampled the Katonah well and other local wells for contamination. These samples revealed the presence of tetrachloroethylene (PCE) and other VOCs in the well water. These contaminants were traced to a local septic waste collector who was disposing of wastes taken from several Katonah dry-cleaning establishments. In 1978 the Katonah well was closed and source-control measures were initiated requiring dry cleaning establishments to pump out their septic systems and modify solvent-disposal techniques. Initial attempts by WCDH and the Town of Bedford to remove contamination from the affected aquifer failed. The primary contaminant of concern affecting the ground water is PCE.

31174 **(PB—88-185764/XAB) Superfund Record of Decision (EPA Region 2): Vega Alta Public Supply Wells, Puerto Rico (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 82p. (EPA/ROD/R—02-87/050). NTIS, PC A05/MF A01.

The Vega Alta Public Supply Wells site is a public water supply well field located in the municipality of Vega Alta, Puerto Rico, approximately 32 km west of San Juan where ground water is the primary source of water. The well field consists of eight active wells. It currently supplies about 3.8 million gallons per day of water to Vega Alta and surrounding residential areas. The Puerto Rico Aqueduct and Sewer Authority (PRASA) is responsible for operation and maintenance of the public water-supply system. The first indication of contamination was discovered in June 1983, when a survey of public water wells made by the U.S. Geological Survey detected 574 ug/1 of trichloroethylene (TCE) in the Ponderosa public supply well. Other VOCs were detected at lower concentrations in non-public wells in the well field system and ground water contamination was suspected. In June and August of 1983 Ponderosa and well GE 1 were shut down by PRASA because of contamination, respectively. This shutdown caused a potential water supply shortage in Vega Alta. PRASA constructed well Bajura 3 to eliminate the shortage. In 1984 an air stripper was constructed at the Ponderosa well and operated until May 1985 when technical problems arose with the air stripper. Currently, ground water is contaminated with 1,1,1-trichloroethene, tetrachloroethene, 1,2-dichloroethene, 1,1-dichloroethene and other VOCs.

31175 **(PB—88-185772/XAB) Superfund Record of Decision (EPA Region 2): Endicott Village Well Field, Broome County, New York (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1987. 41p. (EPA/ROD/R—02-87/048). NTIS, PC A03/MF A01.

The Endicott Village Well Field site is located in Endicott Village, Broome County, New York. the site consists of a Ranney well and its zone of influence on area ground water. Landfills and industrial tracts of land are located to the northwest and west of the study area including the Endicott Landfill, identified as the

probable source of contamination. In the 1950s the Ranney Well Collector Corporation developed the well comprising the site for use by the Village of Endicott. After a May 1981 chemical spill nearby, the well was sampled and found to contain vinyl chloride and trace amounts of other VOCs. Remedial actions undertaken by the Endicott Public Works Department included sampling and eventual closing of radial discharges from the Ranney well. Additionally, an aeration system was installed in the well to reduce vinyl chloride levels. Subsequent actions undertaken included the installation of monitoring wells and a purge well between the Ranney well and the Endicott Landfill. Further studies are currently being conducted to determine the source of contamination and to develop final aquifer restoration alternatives. The studies will be addressed in a subsequent Record of Decision. The primary contaminants of concern include; vinyl chloride and other VOCs.

31176 **(PB—88-185780/XAB) Superfund Record of Decision (EPA Region 2): Renora Inc., Middlesex County, New Jersey (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 93p. (EPA/ROD/R—02-87/051). NTIS, PC A05/MF A01.

The Renora Inc. site, in Middlesex County, New Jersey, occupies a one-acre parcel of land in an area zoned for light industrial use. Within 2000 feet of the site is a residential area with a nursery school, a senior citizens center, and an apartment complex. The site consists of relatively flat land built up from a 100-year flood plain with three to twelve feet of demolition debris. From 1978 to 1982 Renora, Inc., certified as a collector/hauler of waste oils, transported and accepted materials containing hazardous substances for transfer, storage, blending and ultimately, disposal through abandonment at the site. State and local inspection reports indicate that the site was poorly maintained throughout the period of its operation. In July 1978 the New Jersey Department of Environmental Protection (NJDEP) detected several minor spills and determined that Renora, Inc. was acting as a Special Waste Transfer Station without proper registration. Subsequently, Renora was ordered to remove all contaminated soil and drums. In May 1979 drums were leaking on the property.

31177 **(PB—88-188263/XAB) Superfund Record of Decision (EPA Region 4): NW 58th Street Landfill, Dade County, Florida, September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 21 Sep 1987. 43p. (EPA/ROD/R—04-87/027). NTIS, PC A03/MF A01.

The Northwest 58th Street Landfill, one of three NPL sites that comprise the Biscayne Aquifer Superfund Study, is a one-square-mile site in northwest Dade County, Florida, which is bordered by a rock-pit operation and a resource-recovery plant. The site is located in an area where the ground-water table is two to three feet below the ground surface. From 1952 to 1982, the site operated as a municipal landfill receiving approximately 60,000 tons of waste in 1952 and increasing annually over the thirty years of operation to over 1,000,000 tons per year in the 1980s. Small quantities of hazardous materials from households (e.g., pesticides, paints, solvents, etc.) was considered to be municipal waste and also disposed of at the landfill. In 1975, the landfill operation initiated a program of providing daily cover to the site; however, prior to this, the operation did not compact wastes or add daily cover. As a result of earlier practices, the landfill is believed to be saturated with water so the volume of rainfall entering the land equals the volume of leachate released. Since October 1982, the landfill has only received debris, quarry wastes, and water paint sludges.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 30055, 31974

31178 **(INIS-XN—1) Decree No. 85-453 of 23 April 1985 in implementation of Act No. 83-630 of 12 July 1983 on democratisation of public inquiries and environmental protection.** (Nuclear Energy Agency, 75 - Paris (France)). 24 Apr 1985. 11p. (In French).

This Decree is the essential instrument for the entry into force of the 1983 Act on democratization of public inquiries. It sets out in the annex the list of activities which must be preceded by a public inquiry in accordance with the Act, and gives the public greater possibilities for intervening in the procedure, as well as guarantees on the independence of inquiry Commissioners.

31179 **(INIS-XN—2) Decree No. 85-449 of 23 April 1985 in implementation of Act No. 83-630 of 12 July 1983 on democratisation of public inquiries and environmental protection with regard to major nuclear installations.** (Nuclear Energy Agency, 75 - Paris (France)). 24 Apr 1985. 4p. (In French).

Act No. 83-630 of 19 July 1983 on democratization of public inquiries and environmental protection prescribes a public inquiry procedure for work likely to affect the environment. This Decree was made in implementation of the Act. Its scope is set out in an annexed table which provides that this new procedure applies to major nuclear installations governed by Decree No. 63-1128 of 11 December 1963 on nuclear installations and their radioactive effluent releases. The definition of a major nuclear installation which, until now, was set out in orders, is henceforth included in the 1963 Decree which is amended by the above Decree. As regards substance, the main modifications concerning nuclear installations are those directly resulting from the 1983 Act: one month's duration at least for the inquiry, designation of an inquiry commissioner by the president of the administrative court, stay of execution decided ipso facto by the judicial authority in case of the inquiry commissioner's negative opinion.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 30412

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 31358, 31359

5502 Biochemistry

REFER ALSO TO CITATION(S) 30163, 30164, 30165, 30192, 30194, 30195, 30196, 30778, 31190, 31191, 31276, 31280

31180 **(BNL—40995) Energy and complex industrial systems environmental emissions data reporting and acquisition.** Moskowitz, P.D.; Hamilton, L.D. (Brookhaven National Lab., Upton, NY (USA)). Jul 1987. Contract AC02-76CH00016. 31p. (CONF-8706287—1).

From Workshop for the preparation of guidelines for the joint IAEA/UNEP/WHO Project - assessing and managing health and environmental risks from energy and other complex industrial systems; Upton, NY, USA (29 Jun 1987).

The Joint International Atomic Energy Agency (IAEA), UNEP and WHO Project on Assessing and Managing Health and Environmental risks from Energy and Other Complex Technologies intends to complile emissions data for mportant energy sys-

tems and other complex technologies from a wide variety of countries. To facilitate data generation and compilation, this report: outlines data reporting protocols; identifies potential information sources; demonstrates how to estimate coefficients; presents some compiled US emission coefficients or criteria air pollutants for some energy process; and, compares national air emission standards for electricity generating plants in OECD member countries. 27 refs., 2 fis., 1 tabs.

31181 **(DOE/ER/13505—1) [Mechanisms of inhibition of viral replication in plants]: Progress report.** Palukaitis, P. (Cornell Univ., Ithaca, NY (USA). Dept. of Plant Pathology). 1988. Contract FG02-86ER13505. 4p.

The genome of cucumber virus (CMV) was cloned and about 300 clones were obtained that contained CMV sequences. These were further subdivided into clones that were derived from RNAs 3 and 4, and those that were not, and thus represented RNAs 1 and 2.

31182 **(DOE/ER/13534—T1) [Carbon isotope fractionation in plants]: Annual technical progress report.** O'Leary, M.H. (Wisconsin Univ., Madison (USA)). [1988]. Contract FG02-86ER13534. 7p.

Plants fractionate carbon isotopes during photosynthesis in ways which reflect photosynthetic pathway and environment. The fractionation is product of contributions from diffusion, carboxylation and other factors which can be understood using models which have been developed in our work. The object of our work is to use this fractionation to learn about the factors which control the efficiency of photosynthesis. Unlike previous studies, we do not rely principally on combustion methods, but instead develop more specific methods with substantially higher resolving power. We have recently developed a new short-term method for studying carbon isotope fractionation which promises to provide a level of detail about temperature, species, and light intensity effects on photosynthesis which has not been available until now. We are studying the isotopic compositions of metabolites (particularly aspartic acid) in C_3 plants in order to determine the role of phosphoenolpyruvate carboxylase in C_3 photosynthesis. We are studying the relative roles of diffusion and carboxylation in nocturnal CO_2 fixation in CAM plants. We are studying the use of isotopic content as an index of water-use efficiency in C_3 plants. We are developing new methods for studying carbon metabolism in plants. 3 refs.

31183 **(DOE/ER/13709—1) Molecular characterization of phytochrome from green avena: Progress report.** Pratt, L.H. (Georgia Univ., Athens (USA). Dept. of Botany). 01 Feb 1988. Contract FG09-87ER13709. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007219/JAW.

During the past year, the focus of theses studies was towards improvements in the purification protocol for green-oat phytochrome, and the generation of antibodies that are needed for future work. The goal of this work is to develop a quantiative immunoassay that will be specific for green-oat phytochrome (that is, willnot be influenced by the presence of etiolated-oat phytochrome), and to identify the gene that encodes green-oat phytochrome, whether it be the same or different than that which encodes etiolated-oat phytochrome.

31184 **(LA-UR—88-413) Solution structures of calcium regulating proteins: A small-angle scattering study.** Trewhella, J.;Heidorn, D.B.;Seeger, P.A. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 21p. (CONF-871190—4).

From Workshop on neutron scattering; Los Alamos, NM, USA (3 Nov 1987).

Small-angle X-ray scattering (SAXS) experiments have shown that the solution structures of two calcium-binding regulatory proteins, calmodulin and troponin C, are significantly different from their crystal structure forms. The structural differences occur in a region of calmodulin that is thought to bind to target enzymes;the calmodulin-enzyme complex is an initiator for many important biochemical processes. Calcium binding to calmodulin induces a conformational change that is a prerequisite for calmodulin binding to a target enzyme. SAXS data can characterize this conformational change and give insight into the mechanism of enzyme binding. Neutron resonance scattering promises to determine accurately the distances between calcium binding sites, thus providing important constraints on the structure of calmodulin in solution. 24 refs., 5 figs., 1 tab.

31185 **(LBL—24830) Sequence dependent structure and thermodynamics of DNA oligonucleotides and polynucleotides: uv melting and NMR (nuclear magnetic resonance) studies.** Aboul-ela, F.M. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 159p.

Thermodynamic parameters for double strand formation have been measured for the twenty-five DNA double helices made by mixing deoxyoligonucleotides of the sequence dCA_3XA_3G with the complement dCT_3YT_3G. Each of the bases A, C, G, T, and I (I = hypoxanthine) have been substituted at the positions labeled X and Y. The results are analyzed in terms of nearest neighbors. At higher temperatures the sequences containing a G{center←dot}C base pair become more stable than those containing only A{center←dot}T. All molecules containing mismatcher are destabilized with respect to those with only Watson-Crick pairing, but there is a wide range of destabilization. Large neighboring base effects upon stability were observed. For example, when (X, Y) = (I, A), the duplex is eightfold more stable than when (X, Y) = (A, I). Independent of sequence effects the order of stabilities is: I{center←dot}C {succ} I{center←dot} A{succ} I{center←dot}T ~ I{center←dot}G. All of these results are discussed within the context of models for sequence dependent DNA secondary structure, replication fidelity and mechanisms of mismatch repair, and implications for probe design. The duplex deoxyoligonucleotide d(GGATGGGAG){center←dot}d(CTCCCATCC) is a portion of the gene recognition sequence of the protein transcription factor IIIA. The crystal structure of this oligonucleotide was shown to be A-form The present study employs Nuclear Magnetic Resonance, optical, chemical and enzymatic techniques to investigate the solution structure of this DNA 9-mer. (157 refs., 19 figs., 10 tabs.)

31186 **(PB—88-171228/XAB) DNA (deoxyribonucleic acid) synthesis following microinjection of heterologous sperm and somatic cell nuclei into hamster oocytes.** Naish, S.J.; Perreault, S.D.; Zirkin, B.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 14p. (EPA—600/J-87/269). NTIS, PC A03/MF A01.

Pub. in Gamete Research, Vol. 18, 109-120(1987).

The authors investigated the ability of the hamster oocyte to initiate DNA synthesis in nuclei differing in basic protein content. DNA synthesis was studied by autoradiography in oocytes that had been incubated in ^{3}H-thymidine after being parthenogenetically activated by sham microinjection, or microinjected with hamster, mouse, rabbit, or fish sperm nuclei, or hamster hepatocyte nuclei. Within 6 hr of sham or nucleus microinjection, nuclei of each type underwent transformation into pronuclei and synthesized DNA. These results demonstrated that the hamster egg can access and utilize its own and each type of template provided, whether homologous or heterologous. However, pronuclei derived from hamster sperm nuclei were more likely to be synthesizing DNA at 6 hr than pronuclei derived from sperm nuclei of other species. The authors conclude that the mechanisms employed by the hamster oocyte to transform hamster sperm nuclei into pronuclei and to effect DNA synthesis in these nuclei are not specific for the hamster sperm nucleus. Nevertheless, these mechanisms apparently operate more efficiently when the hamster sperm nucleus, rather than a heterologous sperm nucleus, is present.

31187 **RAD3 gene of Saccharomyces cerevisiae encodes a DNA-dependent ATPase.** Sung, P.; Prakash, L.; Weber, S.; Prakash, S. (Univ. of Rochester, NY (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 17, 6045-6049(Sep 1987). Contract FG02-85ER60281.

The RAD3 gene of the yeast Saccharomyces cerevisiae is required for excision repair of damaged DNA and for cell viability. A protein of $\approx$ 89 kDa was purified to near homogeneity from yeast strains harboring multicopy plasmids that overproduce RAD3 protein; this protein corresponds closely to the expected size of the RAD3 protein and crossreacts with the antiserum raised against a

truncated RAD3 protein produced in Escherichia coli. The purified RAD3 protein shows a single-stranded DNA-dependent ATPase activity that catalyzes hydrolysis of ATP to ADP and P/sub i/. The ATPase activity was coincident with the RAD3 protein during purification and is inhibited by anti-RAD3 antibodies, indicating that the RAD3 gene encodes this activity.

31188 **High rates of deletions in the constant region segment of the immunoglobulin μ gene.** Jaeck, H.M.; Wabl, M. (Univ. of California, San Francisco (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 14, 4934-4938(Jul 1987). Contract AC03-76SF01012.

Spontaneous deletions at the immunoglobulin heavy-chain locus are frequently found in myelomas, hybridomas, and pre-B-cell lines. The authors have measured the rates for large and small deletions within the constant-region gene segment for μ chain in a pre-B-cell line. The large deletions, which include the entire first and second exons, occurred at a rate of 1.7×10^{-5} per cell generation. The small deletions, which span a few base pairs, occurred at a rate of 1.4×10^{-7} per cell generation. The rate for the reversion of a termination codon in the second exon is even less than that for the small deletions and is 1000 times lower than the reversion rate that had been determined for the variable-region gene segment. Therefore, the variable-region gene segment is likely to be the preferred target for hypermutation.

31189 **Physical characterization of a nucleic acid junction.** Seeman, N.C.; Maestre, M.F.; Ma, R.I.; Kallenbach, N.R. (Dept. of Biological Sciences, SUNY Albany, Albany, NY 12222 (USA)). pp 99-108 of Molecular basis of cancer. Rein, R. New York, NY; Alan R. Liss Inc. (1985). (CONF-8405214—).

From Molecular basis of cancer conference; Buffalo, NY, USA (29 May 1984).

Normally unstable transient states of DNA, in which the linear duplex branches to form junctions with three or more arms, can be studied at the oligonucleotide level if their sequences are carefully selected. The authors designed a series of oligonucleotide complexes with sequences that are restricted to prevent any major overlap among the arms, and chosen to exhibit high equilibrium stabilities, as well. The electrophoretic mobility of these complexes on polyacrylamide gels permits them to demonstrate formation of a stable four-strand complex with 1:1:1:1 stoichiometry. The authors review here the evidence for formation of a stable stoichiometric junction, and present new circular dichroism data showing that the arms remain in B helix geometry within the complex, and that no significant loss of structure occurs on forming a junction.

5503 Cytology

REFER ALSO TO CITATION(S) 31186, 31347

5504 Genetics

REFER ALSO TO CITATION(S) 30193, 30194, 31276

31190 **(DOE/ER/60271—T1) Structure and function of the human metallothionein gene family: Final technical report.** Karin, M. (University of Southern California, Los Angeles (USA). Dept. of Medicine). [1986]. Contract FG03-84ER60271. 3p.

The full nucleotide sequence of two additional human metallothionein (hMT) genes has been determined. These genes, hMT-I/sub B/ and hMT-I/sub F/, are located within the MT-I gene cluster we have described originally. The hMT-I/sub F/ gene is the first hMT-I gene whose amino acid sequence is in complete agreement with the published sequence of the human MT-I proteins. Therefore it is likely to be an active gene encoding a functional protein. However, since we have just completed the sequence analysis, we have not characterized this gene further yet. The hMT-I/sub B/ gene is closely linked to the hMT-I/sub A/ gene, and two pseudogenes, hMT-I/sub C/ and hMT-I/sub D/ separate the two. From its nucleotide sequence hMT-I/sub B/ seems to be an active gene, encoding a functional protein even though it differs in four positions from the published sequence of human MT-I proteins. This gene is expressed in a human hepatoma cell line, HepG2, and its expression is stimulated by Cd^{++}. Using gene fusions to the viral thymidine-kinase gene we find that hMT-I/sub B/, like the hMT-I/sub A/ and hMT-II/sub A/ genes, contains a heavy metal responsive promoterregulatory element within its 5' flanking region. We analyzed the level of hMT-I/sub B/ mRNA in a variety of human cell lines by the S1 nuclease technique, and compared it to the expression of the hMT-II/sub A/ gene. While the hMT-II/sub A/ gene was expressed in all of the cell lines analyzed, the hMT-I/sub B/ gene was expressed in liver and kidney derived cell lines cells. This suggest that the expression of the hMT-I/sub B/ gene is controlled in a tissue specific manner. 13 refs.

31191 **(LA-UR—88-450) The human genome: Computational challenges.** Bell, G.I. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 19p. (CONF-880567—2).

From 3. international conference on supercomputing; Boston, MA, USA (15 May 1988).

The deoxyribonucleic acid (DNA) of a human cell contains all the information required for specifying that cell, or indeed the whole person, and constitues the human genome. Programs are now underway to obtain genetic linkage maps and physical maps of human chromosomes containing the DNA, and large scale efforts will soon begin to provide detailed sequences. The challenges involved in assembling these data into a knowledge base are examined. Computations will play a key role in enabling the scientists to understand the information contained in sequence data. Pattern recognition and string matching algorithms will be of particular importance. Recent results in the use of adaptive networks for pattern detection will be presented. 19 refs.

31192 **Characterization of a panel of somatic cell hybrids for regional mapping of the mouse X chromosome.** Avner, P.; Arnaud, D.; Amar, L.; Cambrou, J.; Winking, H.; Russell, L.B. (Institut Pasteur, Paris (France)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 15, 5330-5334(Aug 1987). Contract AC05-84OR21400.

A panel of five hybrid cell lines containing mouse X chromosomes with various deletions has been obtained by fusing splenocytes from male mice carrying one of a series of reciprocal X-autosome translocations with the azaguanine-resistant Chinese hamster cell line CH3g. These hybrids have been extensively characterized by using the allozymes hypoxanthine/guanine phosphoribosyltransferase (encoded by the Hprt locus) and α-galactosidase (Ags) and a series of 11 X-chromosome-specific DNA probes whose localization had been previously established by linkage studies. Such studies have established the genetic breakpoints of the T(X;12)13R1 and T(X;2)14R1 X-autosome translocations on the X chromosome and provided additional information as to the X-chromosome genetic breakpoints of the T(X;16)16H, T(X;4)7R1, and T(X;7)6R1 translocations. The data establish clearly that both the T(X;7)5RI and T(X;12)13R1 X-chromosome breakpoints are proximal to Hprt, the breakpoint of the former being more centromeric, lying as it does in the 9-centimorgan interval between the ornithine transcarbamoylase (Otc) and DXPas7 (M2C) loci. These five hybrid cell lines provide, with the previously characterized EBS4 hybrid cell line, a nested series of seven mapping intervals distributed along the length of the mouse X chromosome. Their characterization not only allows further correlation of the genetic and cytological X-chromosome maps but also should permit the rapid identification of DNA probes specific for particular regions of the mouse X chromosome.

31193 **Interleukin 3 gene is located on human chromosome 5 and is deleted in myeloid leukemias with a deletion of 5q.** Le Beau, M.M.; Epstein, N.D.; O'Brien, S.J.; Nienhuis, A.W.; Yang, Y.C.; Clark, S.C.; Rowley, J.D. (Univ. of Chicago, IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 16, 5913-5917(Aug 1987). Contract FG02-86ER60408.

The gene IL-3 encodes interleukin 3, a hematopoietic colony-stimulating factor (CSF) that is capable of supporting the proliferation of a broad range of hematopoietic cell types. By using

somatic cell hybrids and in situ chromosomal hybridization, the authors localized this gene to human chromosome 5 at bands q23-31, a chromosomal region that is frequently deleted [del(5q)] in patients with myeloid disorders. By in situ hybridization, IL-3 was found to be deleted in the 5q-chromosome of one patient with refractory anemia who had a del(5)(q15q33.3), of three patients with refractory anemia (two patients) or acute nonlymphocytic leukemia (ANLL) de novo who had a similar distal breakpoint [del(5)(q13q33.3)], and of a fifth patient, with therapy-related ANLL, who had a similar distal breakpoint in band q33[del(5)(q14q33.3)]. Southern blot analysis of somatic cell hybrids retaining the normal or the deleted chromosome 5 from two patients with the refractory anemia 5q- syndrome indicated that IL-3 sequences were absent from the hybrids retaining the deleted chromosome 5 but not from hybrids that had a cytologically normal chromosome 5. Thus, a small segment of chromosome 5 contains IL-3, GM-CSF, CSF-1, and FMS. The findings and earlier results indicating that GM-CSF, CSF-1, and FMS were deleted in the 5q-chromosome, suggest that loss of IL-3 or of other CSF genes may play an important role in the pathogenesis of hematologic disorders associated with a del(5q).

31194 **Computational analysis of genetic sequences.** Goad, W.B. (Theoretical Biology and Biophysics, Los Alamos National Lab., Univ. of California, Los Alamos, NM 87545 (US)). pp 79-96 of Annual review of biophysics and biophysical chemistry, Volume 15. Engelman, D.M. Palo Alto, CA; Annual Reviews Inc. (1986). Contract W-7405-ENG-36.

Much computational processing of sequence data can be accomplished by applying the kinds of computational tools and processes widely used in text processing, perhaps specialized to sequences, but not necessarily so. Thus many investigators use ordinary text editors or word-processing programs to assemble and manipulate sequence data, but specialized editors have also been developed. At GenBank, for example, the SEQEDIT program formats and manipulates sequence data in conformity with the structure of the GenBank database while communicating with the user through keyboard and cursor of a screen terminal in much the same way as any number of screen-oriented word-processing programs. A number of other programs have been developed specifically to assist in assembling sequences from individually sequenced restriction fragments. As in the case of restriction sites, many sequence patterns of biological interest are essentially lexically defined, and can be dealt with by text-processing methods. However, the specifically biological problems of identifying evolutionary and functional relatedness between sequences have led to development of computational tools that go beyond anything from the text-processing area. The author first sketches the use of text-processing tools in sequence analysis and then goes on to methods for identifying homology and other relationships within and between sequences. He has tried to include the most active areas of actual application in molecular genetics, although the important area of secondary structure prediction is omitted.

5505 Metabolism

REFER ALSO TO CITATION(S) 30190, 31279

31195 **(DOE/ER/13495—2) Anaerobic metabolism of aromatic compounds by phototrophic bacteria: Progress report, [year 2].** Harwood, C.S. (Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology). 1988. Contract FG02-86ER13495. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007649/JAW.

Various aromatic compounds can be broken down anaerobically a model oganism, Rhodopseudomonas palustris. These results show that R. palustris is one of the most versatile of the anaerobic bacteria described to date with respect to aromatic degradation. The probable metabolic routes taken were assessed by analyzing growth patterns and the accumulation of partial degradation products by wild type strains and by a mutant blocked in anaerobic degradation of benzoate and 4-hydroxybenzoate. The main conclusion reached from these studies is that R. palustris uses two major routes for aromatic degradation; one that flows through benzoate and one that flows through 4-hydroxybenzoate. Thus there appear to be two major pathways that mediate the fission of aromatic rings under anaerobic conditions. 7 refs., 2 figs.

5506 Medicine

31196 **(BNL—40761) The role of high-energy synchrotron radiation in biomedical trace element research.** Pounds, J.G.;Long, G.J.;Kwiatek, W.M.;Jones, K.W.;Gordon, B.M.;Hanson, A.L. (Brookhaven National Lab., Upton, NY (USA)). [1987]. Contract AC02-76CH00016. 6p. (CONF-8708180—6).

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

This paper will present the results of an investigation of the distribution of essential elements in the normal hepatic lobule. the liver is the organ responsible for metabolism and storage of most trace elements. Although parenchymal hepatocytes are rather uniform histologically, morphometry, histochemistry, immunohistochemistry, and microdissection with microchemical investigations have revealed marked heterogeneity on a functional and biochemical level. Hepatocytes from the periportal and perivenous zones of the liver parrenchyma differ in oxidative energy metabolism, glucose uptake and output, unreagenesis, biotransformation, bile acid secretion, and palsma protein synthesis and secretion. Although trace elements are intimately involved in the regulation and maintenance of these functions, little is known regarding the heterogeneity of trace element localization of the liver parenchyma. Histochemical techniques for trace elements generally give high spatial resolution, but lack specificity and stoichiometry. Microdissection has been of marginal usefulness for trace element analyses due to the very small size of the dissected parenchyma. The characteristics of the high-energy x-ray microscope provide an effective approach for elucidating the trace element content of these small biological structures or regions. 5 refs., 1 fig., 1 tab.

31197 **(BNL—40770) X-ray microscopy studies on the pharmaco-dynamics of therapeutic gallium in rat bones.** Bockman, R.; Repo, M.; Warrell, R.; Pounds, J.G.; Kwiatek, W.M.; Long, G.J.; Schidlovksy, G.; Jones, K.W. (Memorial Sloan-Kettering Cancer Center, New York (USA); Brookhaven National Lab., Upton, NY (USA)). [1987]. Contract AC02-76CH00016. 6p. (CONF-8708180—7).

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

We describe here our preliminary results on gallium and calcium quantitation and localization using x-ray microscopy techniques at the X-26 beam line of the National Synchrotron Light Source (NSLS) at 50 to 100 μm resolution and 10/sup {minus/6} gg detection levels. Since the original observation of exogenous gallium accumulation in bones, several studies have demonstrated that gallium nitrate is extremely effective in preserving boen mienral content both in vivo and in vitro. Gallium nitrate therapy normalized serum calcium levels in a study of patients with caner-related hypercalcemia, resistant to standard hydration and diuretic therapy. Recently, gallium nitrate treatment has been shown to halt the accelerated bone resorption that is frequently associated with cancers metastatic to bone. Several lines of evidence from vitro studies recently led to the demonstration of increased bone calcium and improvement in hydroxyapatite crystallinity in adult gallium-treated rats. Evidence is rapidly accumulating that gallium nitrate is an effective, new therapeutic agent for inhibition of accelerated bone resorption associated with cancer-related hypercalcemia. It has also been suggested that gallium could have wide clinical applications in disorders characterized by accelerated calcium loss from bone. 7 refs., 3 figs., 1 tab.

31198 **(DOE/ER/60040—1) Chemoradiotherapy of cancer: Boronated antibodies and boron-containing derivatives of chlorpromazine and porphyrins for neutron capture therapy.** Soloway, A.H. (Ohio State Univ. Research Foundation, Columbus (USA)). [1988]. Contract AC02-82ER60040. 4p.

Monoclonal antibodies directed against tumor associated antigens have been proposed for the selective targeting of malignant cells with boron-10. The purpose of this task was to optimize

the conditions for linking a large number of boron atoms to antibody molecules without compromising the antibody's immunoreactivity. There has been a need to develop methodologies for the separation, purification and characterization of such immunoconjugates prior to their evaluation both under in vitro and in vivo conditions. During this project period, much of the effort has concentrated on MoAb 17-1A which is directed against human colorectal cancer. The observed selective concentration of chlorpromazine in melanotic tissue and its high localization in murine melanoma indicated that boronated analogues of chlorpromazine potentially could be used to deliver sufficient concentration of boron-10 for BNCT of melanomas. Five boronated promazines have been synthesized and fully characterized. The phthalocyanines, as with various porphyrins, have been shown to be incorporated to a significant extent in malignant tumors. As a consequence, we have undertaken the synthesis of boron-containing phthalocyanines. Initial efforts have concentrated on the sulfonation of copper phthalocyanine by chlorosulfonation followed by reaction with aminocarboranes such as p-amino-phenylcarborane. We have achieved an average of 18 boron atoms per phthalocyanine molecule. 1 fig.

31199 **(DOE/ER/60561—2) New techniques for positron emission tomography in the study of human neurological disorders: Progress report, December 15, 1987-June 14, 1988.** Kuhl, D.E. (Michigan Univ., Ann Arbor (USA). Div. of Nuclear Medicine). Feb 1988. Contract FG02-87ER60561. 6p.

A brief progress report is presented describing the preparation and animal testing of ^{11}C scopolamine and ^{18}F fluoride. Additional studies entitled "Automated Arterial Blood Sampling System for PET," Rapid Data Analysis Schemes for Functional Imaging in PET," and "Tracer Kinetic Modeling in PET Measures of Cholinergic Receptors" are described.

31200 **(INIS-BR—1076) Quality of radiant treatment in tumors of urinary bladder and prostate.** Berenchtein, M.A. (Hospital do Servidor Publico Estadual de Sao Paulo (Brazil)). [1988]. 1p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702774/JAW.

31201 **(INIS-BR—1078) Cell-mediated immunity in patients with carcinoma under immunotheraphy.** Almeida, C.E. (Escola Paulista de Medicina, Sao Paulo (Brazil)). 1985. 120p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88702776/JAW.

'In vivo' and 'in vitro' cellular immunity is evaluated in 32 patients with carcinoma under immunotheraphy with subcutaneous or endovenous glucan, transfer factor and levamisole. The immunotheraphy is done relatively by intradermal tests with common antigens, by sensitization with dinitrochlorinebenzene and lymphocytes culture from whole blood. The levels of blood serum of human T lymphotocyte soluble receptor for sheep erythrocytes are detected. (M.A.C.).

31202 **(LBL—23357) MLE [Maximum Likelihood Estimator] reconstruction of a brain phantom using a Monte Carlo transition matrix and a statistical stopping rule.** Veklerov, E.; Llacer, J.; Hoffman, E.J. (Lawrence Berkeley Lab., CA (USA); California Univ., Los Angeles (USA). Dept. of Radiological Sciences). Oct 1987. Contract AC03-76SF00098. 5p. (CONF-871006—51).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

In order to study properties of the Maximum Likelihood Estimator (MLE) algorithm for image reconstruction in Positron Emission Tomographyy (PET), the algorithm is applied to data obtained by the ECAT-III tomograph from a brain phantom. The procedure for subtracting accidental coincidences from the data stream generated by this physical phantom is such that he resultant data are not Poisson distributed. This makes the present investigation different from other investigations based on computer-simulated phantoms. It is shown that the MLE algorithm is robust enough to yield comparatively good images, especially when the phantom is in the periphery of the field of view, even though the underlying assumption of the algorithm is violated. Two transition matrices are utilized. The first uses geometric considerations only. The second is derived by a Monte Carlo simulation which takes into account Compton scattering in the detectors, positron range, etc. in the detectors. It is demonstrated that the images obtained from the Monte Carlo matrix are superior in some specific ways. A stopping rule derived earlier and allowing the user to stop the iterative process before the images begin to deteriorate is tested. Since the rule is based on the Poisson assumption, it does not work well with the presently available data, although it is successful wit computer-simulated Poisson data.

31203 **(LBL—24315) A positron tomograph with 600 BGO [bismuth germanate] crystals and 2.6 mm resolution.** Derenzo, S.E.; Huesman, R.H.; Cahoon, J.L.; Geyer, A.B.; Moses, W.W.; Uber, D.C.; Vuletich, T.; Budinger, T.F. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 14p. (CONF-871006—48).

From 34. nuclear science symposium and 19. nuclear power systems symposium; San Francisco, CA, USA (21 Oct 1987).

We describe the imaging performance of the Donner 600-Crystal Positron Tomograph, a single 600 cm diam ring of 3 mm wide bismuth germanate (BGO) crystals coupled individually to 14 mm phototubes. With a pulse height threshold of 200 keV and a slice thickness of 5 mm, the sensitivity is 7024 eventssec per μCiml in a 20 cm cyliner of water. The measured rates for 18 μCiml are 95,000 truessec plus 20,000 randomsec. A 0.3 mm diam ^{22}Na line source near the center of the tomograph has a circular point spread function (PSF) with a full-width at half-maximum (fwhm) of 2.6 mm. At 5 cm from the center the PSF is elliptical with a fwhm of 2.7 mm tangential {times} 3.2 mm radial. At 10 cm the PSF has a fwhm of 2.8 mm tangential {times} 4.8 mm radial. Attenuation data are accumulated with a 20 mCi ^{68}Ge orbiting transmission source and 100 million coincident events are collected in 200 sec. 20 refs., 9 figs., 5 tabs.

31204 (SSA—1987-TS-8, pp 203-204) **Post-transfusion survival of stored red cells double isotope labelling. II. Comments.** Fabre, G.; Saint-Blancard, J.; Noel, L. (Centre de Transfusion Sanguine des Armees, 92 - Clamart (FR); Centre de Transfusion Sanguine et d'Hematologie, 78 - Versailles (FR)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

The authors present the advantages of the double label method they use (with 51 Cr and 99 m Tc), especially with respect to the 51 Cr and to 125 I used by others. They also review the different factors which influence the method's accuracy.

31205 (SSA—1987-TS-8, pp 235-236) **Radioisotopic cardiac exploration applied to the survey of the navy personnel.** Elizagaray, A.; Puech, B.; Dussarat, G.; Dalger, J. (Centre d'Etudes et de Recherches Biophysiologiques Appliquees a la Marine, 83 - Toulon (FR)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

Due to their non invasive characteristic and ability to evaluate the cardiac function at rest and at work, the radioisotopic explorations are largely used in the survey of Navy personnel.

31206 **Instrumentation in positron emission tomography.** *JAMA, Journal of the American Medical Association;* 259: No. 10, 1531-1536(11 Mar 1988). Contract AC03-76SF00012.

Positron emission tomography (PET) is a three-dimensional medical imaging technique that noninvasively measures the concentration of radiopharmaceuticals in the body that are labeled with positron emitters. With the proper compounds, PET can be used to measure metabolism, blood flow, or other physiological values in vivo. The technique is based on the physics of positron annihilation and detection and the mathematical formulations developed for x-ray computed tomography. Modern PET systems can provide three-dimensional images of the brain, the heart, and other internal organs with resolutions on the order of 4 to 6 mm. With the selectivity provided by a choice of injected compounds, PET has the power to provide unique diagnostic information that is not available with any other imaging modality. This is the first five reports on the nature and uses of PET that have been prepared for the Ameri-

can Medical Association's Council on Scientific Affairs by an authoritative panel.

31207 **Cyclotrons and radiopharmaceuticals in positron emission tomography.** *JAMA, Journal of the American Medical Association;* **259**: No. 10, 1854-1860(11 Mar 1988). Contract AC02-76CH00016.

Positron emission tomography (PET) can prober biochemical pathways in vivo and can provide quantitative data; for that purpose, tracers labeled with positron-emitting radioisotopes are essential. This report describes the tracers that are being used or that may have future use, their production by cyclotrons, and other needed resources for PET imaging. Current routine and automated methods for convenient production of labeled compounds, coupled with simple computer-controlled accelerators, can support the creation of clinical PET centers in any large medical institution, obviating the need for in-depth research teams. An alternate approach involves the development of regional centers that provide in-house service and that supply fluorine 18- and carbon 11- labeled compounds to nearby hospitals with PET machines.

31208 **Structure of the reaction center from Rhodobacter sphaeroides R-26: the cofactors.** Allen, J.P.; Feher, G.; Yeates, T.O.; Komiya, H.; Rees, D.C. (Univ. of California, San Diego, La Jolla (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 16, 5730-5734(Aug 1987).

The three-dimensional structure of the cofactors of the reaction center of Rhodobacter sphaeroides R-26 has been determined by x-ray diffraction and refined at a resolution of 2.8 A with an R value of 26%. The main features of the structure are similar to the ones determined for Rhodopseudomonas viridis. The cofactors are arranged along two branches, which are approximately related to each other by a 2-fold symmetry axis. The structure is well suited to produce light-induced charge separation across the membrane. Most of the structural features predicted from physical and biochemical measurements are confirmed by the x-ray structure.

31209 **Quantitative single-photon emission tomography for cerebral flow and receptor distribution imaging.** Budinger, T.F. (Donner Lab. and Lawrence Berkeley Lab., Dept. of Electrical Engineering and Computer Sciences, Univ. of California, Berkeley, CA 94720 (USA)). pp 227-240 of Positron emission tomography. Reivich, M.; Alavi, A. New York, NY; Alan R. Liss Inc. (1985).

Recently there has been renewed interest in single-photon emission tomography for two major reasons. First, correction methods have been devised for attenuation compensation, nonuniform resolution, and scattered radiation. Second, new radiopharmaceuticals with 1-5% uptake in the brain provide adequate statistics for quantitative imaging of flow using properly designed single-photon tomographic instruments. The lack of commercially available instruments designed specifically to optimize sensitivity for a resolution finer than 15 mm full width at half maximum (FWHM) seems now to be the major deterrent to the widespread use of single-photon emission tomography. But it appears now that some development in this respect also might lead to a widespread renewed interest in single-photon tomography of the brain. Major activities of the past few years can be placed in three distinct categories of instrumentation and methodology.

31210 **Positron emitter-labeled radiotracers - Chemical considerations.** Wolf, A.P.; Fowler, J.S. (Chemistry Dept., Brookhaven National Lab., Upton, NY 11973 (USA)). pp 63-80 of Positron emission tomography. Reivich, M.; Alavi, A. New York, NY; Alan R. Liss Inc. (1985).

Positron emission tomography (PET) is a relatively new scientific tool that has allowed scientists and physicians to address problems in physiology and biochemistry in the living human body at low risk. The acquisition of previously inaccessible information and exploitation of the full potential of PET has thrived on the interdependence and integration of the work of scientists and physicians with expertise in a great number of areas of the physical and biologic sciences. Primarily it is the successes in the area of application to the brain and heart that have occurred over the past seven to eight years that has given major impetus to the currently observed increasingly sophisticated development of both positron emission transaxial tomographs (PETT) and accelerator-produced radiotracers. Given the current exponential growth of output of innovaive research and application in the PET area, it is not unreasonable to predict that these new research modalities will have a major impact on biomedical research and ultimately on routine clinical use in the diagnosis of diseases and as an adjunct to the treatment of disorders. It is the purpose of this article to explore progress and direction in the area of accelerator and radionuclide precursor-labeled compounds with the sole focus being on positron emitters ^{11}C, ^{13}N, ^{15}O and ^{18}F.

31211 **Graph theoretical approach to structure-activity studies: Search for optimal antitumor compounds.** Randic, M. (Dept. of Mathematics and Computer Science, Drake Univ., Des Moines, IA 50311 (USA)). pp v of Molecular basis of cancer. Rein, R. New York, NY; Alan R. Liss Inc. (1985). (CONF-8405214—).

From Molecular basis of cancer conference; Buffalo, NY, USA (29 May 1984).

An approach based on graph theoretical methods for searching the most potent drug among numerous candidate structures is outlined. First, the authors identify the strategic fragment and describe it by suitable graph theoretical invariants. They adopted path numbers derived from suitably weighted bonds as basic invariants. Similarity among structures is quantitatively derived from similarity and differences in atomic path numbers for the strategic fragment. The approach is illustrated on a selection of anti-tumor phenyldialkyltriazenes for which log(1/C) are known. By starting the search with an unsubstituted parent compound, in few steps they located 1-(4-NHCOCH3-Phenyl)-3,3-di-alkyltriazene as the most potent drug among those considered.

5507 Microbiology

REFER ALSO TO CITATION(S) 30018, 31226, 31277

5509 Pathology

REFER ALSO TO CITATION(S) 31032, 31033, 31063, 31156, 31157, 31158, 31159, 31160, 31161, 31162, 31163, 31164, 31165, 31166, 31283, 31286, 31287, 31311, 31314, 31315, 31316, 31338, 31339

31212 **(AD-A—189029/2/XAB) In-vitro toxicity evaluation of ten particulate materials in tracheal organ culture. Contractor report, June 1985-June 1987.** Placke, M.E.; Fisher, G.L. (Battelle Columbus Labs., OH (USA)). Dec 1987. 154p. NTIS, PC A08/MF A01.

This study was conducted to explore alternative toxicological testing methods for assessing the potential health hazard of particulate materials. The in vitro toxic effect of eight particles (graphite fibers, polycrystalline iron whiskers, aluminum dust, nickel-coated graphite fibers, brass dust, Printex L carbon black, micro-260 synthetic graphite dust and KS-2 natural graphite dust) was evaluated on the upper respiratory epithelium of hamster tracheal organ cultures based on microanatomical and histomorphometric changes. Tissue changes induced by the test articles were compared to changes that occurred in tracheal organ cultures exposed to crocidolite asbestos (positive control) and glass beads (negative control), in addition to untreated explants. The relative toxicity of each test particle was characterized base on qualitative histopathologic and morphometric differences relative to the positive and negative controls. Crocidolite asbestos and Ni-coated graphite were the most reactive in this study. Iron whiskers, aluminum dust, and KS-2 graphite caused an intermediate level of tissue response, while the remaining substances did not cause significant tissue responses compared to control explants. The most cytotoxic materials were brass dust and Ni-coated graphite.

31213 **(AD-A—189040/9/XAB) Rat pulmonary alveolar macrophages in-vitro cytotoxicity to six metal dusts. Technical report, May-August 1985.** Anderson, R.S.; Gutshall, L.L.; Thomson, S.A. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Dec 1987. 14p. (CRDEC-TR—88037). NTIS, PC A03/MF A01.

Pulmonary alveolar macrophages (PAMs) were harvested from rats by bronchopulmonary lavage and exposed in vitro to aqueous suspensions of six metal dusts: aluminum, silicated aluminum, carbon, graphite, titanium dioxide, and silica. The LC50 value for each dust was calculated by logarithmic linear regression analysis of the toxicity data from the experimental exposure concentrations. Cytotoxicity was determined by metal concentration-dependent inability of PAMs to exclude the trypan blue dye from their cytroplasm. After exposure, PAMs usually bore numerous bound metal particles; but phagocytosis was rare, probably because the cells were not activated in situ prior to removal from the lungs.

31214 **(CONF-880262—1) Resorcinol: Final goitrogenic product in water from a goitrogenic well.** Gaitan, E.;Jolley, R.L.;Lindsay, R.H.;Cooksey, R.C.;Hill, J.B.;Island, D.P. (Mississippi Univ., Jackson (USA). Medical School; Oak Ridge National Lab., TN (USA); Alabama Univ., Birmingham (USA). Medical School; Vanderbilt Univ., Nashville, TN (USA). Medical School). Feb 1988. Contract AC05-84OR21400. 27p.

From 6. annual international symposium on man and his environment in health and disease; Dallas, TX, USA (28 Feb 1988).

In Candelaria town of Columbia, SA, goiter prevalence among children was 23% in Zone B ($p<0.05$). Socioeconomic conditions, dietary composition, or iodine intake could not explain this difference. Water for the town was supplied by two wells through independent pipeline systems, one located in Zone A and the other in Zone B. Waters from these two wells were combined in a single tank and the whole town was supplied through a common pipeline system. Within a year, goiter prevalence rose to 31% in Zone b, while that in Zone A remained the same, 26% (p,NS). Rats drinking water or activated carbon extracts from Well A developed larger thyroid glands and more pronounced thiourea-like antithyroid effects than rats drinking water or extracts from Well B. Similar results were obtained by the acute in vivo suppression of thyroid ^{131}I-uptake in mice and by two in vitro assays. Elemental analysis and infrared spectromentery of Well A goitrogenic water extracts (GWE) gave similar compositon and common absorption bands to those of aquatic humic substances (HS). The HS, fulvic and humic acids, inhibited thyroid peroxidase (TPO) in vitro with 15% of the potency of propylthiouracil (PTU). GCMS analsysis of GWE identified over 30 organic compounds, including resorcinol. Resorcinol was goitrogenic and antithyroid in 2 different rat strains. Resorcinol appeared to be a final goitrogenic by-product of shale-derived HS contaminating water of the goitrogenic well of Candelaria. 46 refs., 3 figs., 4 tabs.

31215 **(PB—88-170857/XAB) Health and environmental effects profile for allyl alcohol.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1985. 82p. (EPA—600/X-85/396). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for allyl alcohol was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Allyl alcohol has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for allyl alcohol is 0.34 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for allyl alcohol is 100.

31216 **(PB—88-171210/XAB) Mutagenicity in Salmonella of hazardous wastes and urine from rats fed these wastes.** DeMarini, D.M.; Inmon, J.P.; Simmons, J.E.; Berman, E.; Pasley, T.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 14p. (EPA—600/J-87/270). NTIS, PC A03/MF A01.

Pub. in Mutation Research, Vol. 189, 205-216(1987).

15 hazardous industrial-waste samples were evaluated for mutagenicity in the Salmonella plate-incorporation assay using strains TA98 and TA100 in the presence and absence of Aroclor 1254-induced rat liver S9. Dichloromethane/methanol extracts of the crude wastes were also evaluated. 7 of the crude wastes were mutagenic, but only 2 of the extracts of these 7 wastes were mutagenic; extracts of 2 additional wastes also were mutagenic. In addition, 10 of the crude wastes were administered by gavage to F-344 rats, and 24-h urine samples were collected. Of the 10 raw urines evaluated, 3 were mutagenic in strain TA98 in the presence of S9 and beta-glucuronidase. The 3 crude wastes that produced these 3 mutagenic urines were, themselves, mutagenic. Adequate volumes of 6 of the 10 raw urines were available for extraction/concentration. These 6 urines were incubated with beta-glucuronidase and eluted through Sep-Pak C18 columns; the methanol eluates of 3 of the urines were mutagenic, and these were the same 3 whose raw urines also were mutagenic. In general, the C18/methanol extraction procedure reduced the cytotoxicity and increased the mutagenic potency of the urines. To the authors knowledge, this is the first report of the mutagenicity of urine from rodents exposed to hazardous wastes.

31217 **(PB—88-173588/XAB) Chemical Carcinogenesis Research Information System (CCRIS) data bank, 1981-June 1986 (1988 version). Data file.** Cameron, T.P.; Stump, J.M.; Schofield, L. (National Cancer Inst., Bethesda, MD (USA)). 1986. mag tap. NTIS CP T02.

Supersedes PB—86-216819; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

CCRIS is a scientifically evaluated and fully referenced data bank, developed and maintained by the National Cancer Institute (NCI), containing carcinogenicity, tumor promotion, and mutagenicity test results. Data are derived from the scanning of primary journals, current-awareness tools, and a special core set of sources, including a wide range of NCI reports. Test results have been reviewed by experts in carcinogenesis. CCRIS File Structure: CCRIS data fields are arranged in two broad subject categories plus a category for administrative information: Administrative Information, Substance Identification/Use, Carcinogenicity/Tumor Promotion/Mutagenicity Studies. The three data fields within category 2 and the information contained therein are: Carcinogenicity Studies: Species; Strain/Sex; Route; Dose; Tumor site/Type of lesion; Results; Reference. Tumor Promotion Studies; Species; Strain/Sex; Promoter Route; Target Tissue/Type of Lesion, Promoter Doses, Carcinogen Route; Carcinogen Doses; Reference. Mutagenicity studies: Test System; Strain/Indicator; Metabolic Activation; Method; Dose range; Reference. A new file dictionary has been enclosed that is a result of minor changes to the file structure. All other documentation on file at the NTIS is still applicable.

31218 **(PB—88-177183/XAB) Dose-response fallacy in human reproductive studies of toxic exposures.** Selevan, S.G.; Lemasters, G.K. (Environmental Protection Agency, Washington, DC (USA). Reproductive Effects Assessment Group). 1987. 6p. (EPA—600/J-87/271). NTIS, PC A02/MF A01.

Pub. in Jnl. of Occupational Medicine, Vol. 29, No. 5, 451-454(May 1987).

The manner in which exposure is defined can affect the findings of reproductive studies of toxic exposures. The individual end

points potentially examined, such as fetal loss, subfertility, and congenital malformations observed at birth, are on a continuum by severity of effect: the most extreme effects of the three being infertility because no pregnancy is possible, and the least extreme, congenital malformations recognized at birth. End points observed at birth are survivors of a long and complex process. The process yielding one of these adverse end points may result from a number of factors, including level of exposure could result in early fetal loss, whereas a lower one might result in a congenital malformation observed at birth. If the probability of a less-severe end point falls due to increasing probability of more-severe end points with increasing exposure, then a nontraditional dose-response relationship may be observed in the study of one type of outcome.

31219 **(PB—88-180401/XAB) TOXLINE evaluation. Final study report. Report for September 1986-September 1987.** Small, H. (Institute for Scientific Information, Inc., Philadelphia, PA (USA)). Oct 1987. 57p. NTIS, PC A04/MF A01.

In order to provide optimal service to its constituent biomedical user community, the National Library of Medicine(NLM) evaluates the scope and coverage of the TOXLINE data base. TOXLINE is constructed from toxicology subsets obtained from the major secondary services, including Biological Abstracts, Chemical Abstracts, and Index Medicus. TOXLINE contains over 1,500,000 citations and covers the relevant literature from 1965 to date. The evaluation employs bibliometric techniques to analyze how adequately TOXLINE is covering the field of toxicology, with special emphasis on newly emerging areas of scientific research.

31220 **(PB—88-182068/XAB) Health-effects assessment for acenaphthene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 22p. (EPA—600/8-88/010). NTIS, PC A03/MF A01.

See also PB—86-134111.

Because of the lack of data for the carcinogenicity and threshold toxicity of acenaphthene risk assessment values cannot be derived. The ambient water-quality criterion of 0.2 mg/l is based on organoleptic data, which has no known relationship to potential human health effects. Acenaphthene has been shown to produce nuclear and cytological changes in microbial and plant species. Results of acenaphthene mutagenicity studies in microorganisms and carcinogenicity study are negative. Despite the negative results in the newt (Triturus cristatus) the fact that acenaphthene is a polynuclear aromatic hydrocarbon (PAH), a class of chemicals that contain carcinogens, the carcinogenic potential of acenaphthene is of great concern. Inadequate evidence to allow any conclusion regarding carcinogenicity for humans appropriately places acenaphthene in EPA Group D.

31221 **(PB—88-861307/XAB) Toxicity: polymeric materials in medical applications. January 1973-March 1988 (citations from the Rubber and Plastics Research Association data base). Report for January 1973-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 127p. NTIS PC N01/MF N01.

Supersedes PB—87-856001.

This bibliography contains citations concerning toxicological evaluation and testing of polymeric materials in medical applications. Polymeric biomedical materials for mechanical organs and surgical applications are discussed. Biocompatibility, clinical evaluation, and regulations of polymeric medical devices are included. Standards for drug-packaging materials and physicochemical and biological testing of polymeric biomaterials are considered. (This updated bibliography contains 266 citations, 14 of which are new entries to the previous edition.)

31222 **(PB—88-862990/XAB) Chemical and biological warfare: biology, chemistry, and toxicology. February 1981-April 1988 (Citations from the NTIS data base). Report for February 1981-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 186p. NTIS PC N01/MF N01.

Supersedes PB—87-857835.

This bibliography contains citations concerning the toxicology of chemical and biological agents; general biological and medical studies; and the properties, synthesis, and reactions of chemical agents and related compounds. Excluded are studies on the biochemistry and therapy of chemical agents. Other published searches in this series cover detection and warning, defoliants, protection, and general studies. (This updated bibliography contains 348 citations, 98 of which are new entries to the previous edition.)

31223 **(PB—88-863162/XAB) Chemical and biological warfare: defoliants and herbicides. January 1970-April 1988 (Citations from the NTIS data base). Report for January 1970-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 116p. NTIS PC N01/MF N01.

Supersedes PB—87-857843.

This bibliography contains citations concerning the use of defoliants as warfare agents. The studies relate to effectiveness of such agents and their use in South Vietnam, and government policies relating to use and disposal of defoliants. Included are research studies conducted by the Veterans Administration, and at Edgewood Arsenal and Fort Detrick bearing upon warfare defoliants and exposure of humans to these agents. Other published searches in this series on chemical warfare cover detection and warning, protection, general studies, and biological studies, including chemistry and toxicology. (This updated bibliography contains 227 citations, 11 of which are new entries to the previous edition.)

5520 Public Health

REFER ALSO TO CITATION(S) 30407, 31041, 31043, 31214, 31218, 31220, 31285, 31288, 31289, 31290, 31291, 31292, 31293, 31295, 31296, 31297, 31298, 31299, 31300, 31301, 31302, 31303, 31304, 31305, 31306, 31307, 31308, 31309, 31310, 31312, 31313, 31317, 31318, 31319, 31320, 31321, 31322, 31323, 31324, 31325, 31326, 31327, 31328, 31329, 31330, 31331, 31332, 31333, 31334, 31335, 31336, 31337, 31340, 31341

31224 **(PB—88-175013/XAB) NIOSH (National Institute for Occupational Safety and Health) Publications Catalog, 7th edition.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Mar 1987. 662p. (DHHS/PUB/NIOSH—87-115). NTIS, PC A99/MF A01.

Also available from Supt. of Docs. See also 5th edition, PB—83-195883.

The publication is a cumulative catalog of the National Institute for Occupational Safety and Health (NIOSH) numbered publications, Health Hazard Evaluation/Hazard Evaluation and Technical Assistance (HHE/HETA) reports, Contract (CON) reports, Industrywide Study (IW) reports, Control Technology (CT) reports, and Miscellaneous Reports since 1972. The Edition marks the 10th Anniversary of the NIOSH Publications Catalog (1977-1987).

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 30190, 31085, 31181

31225 **(DOE/ER/10288—8) Radiation induced changes in the cuticular hydrocarbons of the granary weevil and their relationships to desiccation and adult mortality: Annual progress report, February 15, 1987 to February 14, 1988.** Sriharan, S. (Selma Univ., AL (USA)). 14 Mar 1988. Contract FG02-86CH10288. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88007595/JAW.

Sitophilus granarius (L) is a major pest of stroed grains and is prone to irradiation treatment. There is considerable scope for use of radiation like Cesium-137 (as a source) as an alternative to chemical treatment for pest control. Study with regard to radiation damage and the effect of environmental factors like temperature and humidity on adult weevil mortality due to radiation effect is limited. Stored-grain insects live in an enviroment where liquid water is seldom available. Waterproofing and conservation of water by the insects is a critical factor for weevil survival. In some insects it has been noted that the rate of water loss through the integument has been associated with changes in the hydrocarbon composition of the epicuticle. Epicuticular hydrocarbons play an important role

in preventing desiccation. Information on the effects of irradiation on epicuticular hydrocarbon of the adult weevils is limited. The present investigation sudies the after effects of radiation damage to granary weevil (Sitophilus granarius (L.) in terms of causing increased water loss from the body, weevil nortality and concommitant changes, if any, in the cuticular hydrocarbons that waterproof the insect. 23 refs., 22 figs., 7 tabs.

31226 **(DOE/ER/13522—T1) [Study of the basis for the competitiveness of Rhizobium japonicum in the nodulation of soybean]: Progress report, [May 1986-May 1987].** Bauer, W.D. (Ohio Univ., Athens (USA)). 1987. Contract FG02-86ER13522. 11p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007766/JAW.

The overall goal of our current studies is to identify cellular and molecular factors that are of central importance to the colonization and infection of host roots by inoculated rhizobia in competition with indigenous soil microbes. This report covers research compelted between May 1986 and May 1987. Progress was made during the past year in areas of the role of motility and chemotaxis in nodule initiation by rhizobia, the further characterization of bacterial adhesion to host root surfaces, the effects of root exudate on bacterial attachment, the effects of bacteria and bacterial culture filtrates on bacterial attachment, the movement of rhizobia on the surface of the growing host root, and the effects of adding various nod mutants of Rhizobium meliloti on nodule formation by co-inoculated wildtype cells. 1 fig., 5 tabs.

31227 **(IC—87/211) Some simple applications of probability models to birth intervals.** Shrestha, G. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702659/JAW.

An attempt has been made in this paper to apply some simple probability mc.lels to birth intervals under the assumption of constant fecundability and varying fecundability among women. The parameters of the probability models are estimated by using the method of moments and the method of maximum likelihood. (author). 9 refs, 2 tabs.

31228 **(INIS-mf—11150) Progressive technologies in the food industry.** Chyleova, L.; Sukova, I. (eds.). (Vyzkumny Ustav Potravinarskeho Prumyslu, Prague (Czechoslovakia)). 1987. 150p. (In Czech, Slovak). (CONF-8704289—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702331/JAW.

From Training course for food technologists; Prague, Czechoslovakia (22 Apr 1987).

The collection of papers presented at the training of food industry specialists contains 14 papers, of which 3 were incorporated in INIS. All deal with the radiation treatment of foods and feeds, various equipment and technologies used for the purpose, major radiation effects and the advantages of irradiation techniques. Also discussed are adverse effects of radiation on foodstuffs, questions of legislation and future prospects. (M.D.).

31229 (INIS-mf—11150, pp 96-112) **Radiation treatment of food.** Sedlackova, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702331/JAW. (CONF-8704289—).

From Training course for food technologists; Prague, Czechoslovakia (22 Apr 1987).

The effects of gamma radiation and electron radiation on foodstuffs, and the required radiation doses for different purposes are discussed. Chemical and biological changes take place during the irradiation of foods. A detailed description is presented of chemical changes in amino acids, proteins, enzymes, saccharides, lipids and vitamins, also described are the effects of radiation on viruses, bacteria, insects and parasites. Some legislative provisions enacted in recent years are referred to and a table is published listing irradiation sources for foods on a world scale. Examples are given of existing industrial irradiation plants in the world. (M.D.).

31230 (INIS-mf—11150, pp 113-123) **Application of ionizing radiation in disinfestation of foods, feeds and other stored products.** Zuska, J. (Vyzkumny Ustav Potravinarskeho Prumyslu, Prague (Czechoslovakia)). 1987. (In Czech). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702331/JAW. (CONF-8704289—).

From Training course for food technologists; Prague, Czechoslovakia (22 Apr 1987).

The effects are described of ionizing radiation on insects and mites, this both lethal and sterilization effects. Technological prerequisites of irradiation and the required equipment are listed. The 0.5 kGy dose represents a universal dose which is lethal to or at least sterilizes all mites and insects. Radiodisinfestation is economically demanding but allows to reduce chemical disinfestation and thereby to reduce the content in foods of chemicals harmful to health. Tables are given of doses required for killing and sterilizing certain species of insects. (M.D.). 2 tabs.

31231 (INIS-mf—11150, pp 124-138) **Current technology and prospects of food irradiation in the world.** Farkas, J. (Zemedelska a Potravinarska Universita, Budapest (Hungary). Ustav Potravinarske Technologie). 1987. (In Czech). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88702331/JAW. (CONF-8704289—).

From Training course for food technologists; Prague, Czechoslovakia (22 Apr 1987).

The use of irradiation techniques for food treatment may significantly reduce losses and remove or reduce food contamination with microbes or pests. The main positive effects are presented of food irradiation and the required radiation doses are given. A more detailed description is presented for suppressing germination, for disinfestation, prolonging shelf-life, delaying ripening, microbial decontamination and the eradication of parasites. The International General Standard for Irradiated Foods was accepted. Interest in food irradiation is increasing in the world. (M.D.). 1 tab.

31232 **(ORNL/tr—88/8) Storm felling assessed by national forest survey.** Janz, K. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. Translation source information not available . 9p.

Immediately following the severe storms of September and November 1969 in southern and central Sweden it was clear that the storm damage that had occurred was among the most extensive suffered by Swedish forests.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 30408, 30409, 31263

31233 **(AD-A—189333/8/XAB) Evaluation of domperidone as a modifier of gamma-radiation-induced emesis. Report for January 1984-January 1986.** Cordts, R.E.; Yochmowitz, M.G.; Hardy, K.A. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Sep 1987. 6p. (USAFSAM-JA—86-4). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Radiation Oncology/Biology/Physics Vol. 13, No. 9, 1333-1337(Sep 1987).

The D2 antidopaminergic drug Domperidone was evaluated singly and in combination with synthetic adrenocorticoid and an H2 antihistamine for its ability to reduce the acute emetic effects of ^{60}Co whole-body radiation. Random-source adult male dogs were fasted 12 hours, fed a standard meal, injected 44 minutes later and irradiated 47 minutes after that. Four groups of dogs were radiated after drug injections as follows: saline (Con), domperidone (Dom), cimetidine + thiethylperazine (Cim+Thi), and dexamethasone + domperidone + cimetidine (Dex+Dom+Cim). Drug quantities for dogs represented 10 mg Dom, 10 mg Thi, 20 mg Dex, and 300 mg Cim for an average human (70 ka, 1.8 m2). Subjects were exposed on an up-down schedule to determine the radiation necessary to produce vomiting in 50% (ED50) of each group. Emesis onset times, offset times, and number of episodes were recorded. The

ED50 of Dex+Dom+Cim was higher than Con. Dom produced more emetic episodes than Con or Dex+Dom+Cim. This drug in combination with an adrenocorticoid and antihistamine significantly raised the emetic threshold while maintaining episodes at a low incidence.

31234 **(AD-A—189828/7/XAB) History of the Army Nuclear Test Personnel Review (ANTPR). Final report, 1978-1987.** (Army and Joint Services Environmental Support Group, Washington, DC (USA)). Sep 1987. 79p. NTIS, PC A05/MF A01.

This report is a history of the Army's effort to develop information on personnel participation in Atmospheric Nuclear Weapons Testing. This report also includes an account of the research and assignment of radiation exposure. A total of 54, 023 Army Nuclear Test participants were identified. All 11,494 veterans who called in during the outreach program were sent letters with their radiation exposure level and amplifying details. The program summary in this report indicates that over $5.6M has been spent on the completed project.

31235 **(BNL—40710) Analytical review of structure and regulation of hemopoiesis.** Cronkite, E.P. (Brookhaven National Lab., Upton, NY (USA)). [1987]. Contract AC02-76CH00016. 29p. (CONF-8710284—1).

From International symposium on stem cells; Ulm, F.R. Germany (24 Oct 1987).

The development of knowledge on the structure of hemopoiesis and its regulation can be divided into four broad areas: descriptive morphology, kinetics of cell proliferation, regulation of rates of cell proliferation through interaction of molecular regulators and their cell surface receptors, and clinical applications. 60 refs., 6 figs.

31236 **(BNL—40909) Relevance of phenotypic variation in risk assessment: The scientific viewpoint.** Setlow, R.B. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 5p. (CONF-861238—1).

From Phenotypic variation in populations: relevance to risk assessment; Upton, NY, USA (7 Dec 1986).

A number of examples are presented indicating the types of variation that may be expected in the responses of the human population to deleterious agents of an endogeneous or exogenous nature. If one assumes that the variations in repair in the normal population are reflected in large variations in carcinogenic risk per unit of exposure, then the dose-response curves at low doses cannot be extrapolated from high doeses without knowing the distribution of sensitivities among humans. The probability of determining this range by ecpidemiological studies on a random population by small. On the other hand, the probability of determining the range by careful genetic and molecular studies appears high enough so that such experiments now are being carried out. They cannot be carried out on real populations, using chronic exposures. Hence, the ability to estimate dose-response relations in the low dose region on human populations can only be by making theoretical constructs that, in turn, are dependent on fundamental research. 12 refs., 2 tabs.

31237 **(BNL—40923) Iron and hydroxyl radicals in lipid oxidation: Fenton reactions in lipid and nucleic acids co-oxidized with lipid.** Borg, D.C.; Schaich, K.M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-8706290—1).

From Symposia on molecular and cellular biology; Los Angeles, CA, USA (29 Jun 1987).

Hydroxyl radicals can initiate lipid peroxidation in liquids, but their high reactivity affords reaction paths so short that they are unlikely to reach lipids in membrane bilayers when formed exteriorly. EPR studies of Fenton-like reactions inducing oxidation in bulk lipids indicate that iron-dependent initiation of lipid oxidation in organelles and vesicles may result from hydroxyl radicals formed within the hydrophobic membrane interiors, where they would be inaccessible to typical hydrophilic radical scavengers. The cytotoxic or cytogenetic results of lipid peroxidation, especially in nuclear membranes, may include radiominetic chemical damage to adjacent DNA or nucleoprotein. Preliminary product analyses of nucleic acid basis cooxidized with lipids in vitro support this view.

31238 **(CONF-870419—1) Sulfur activation in Hiroshima.** Kerr, G.D.; Pace, J.V. III. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p.

From 23. annual meeting of the National Council on Radiation Protection and Measurements; Washington, DC, USA (8 Apr 1987).

In 1979, we attempted to establish the validity of source terms for the Hiroshima and Nagasaki bombs using experimental data on sulfur activation. Close agreement was observed between measured and calculated values for test firings of Nagasaki-type bombs. The calculated values were based on source terms developed by W.E. Preeg at the Los Alamos National Laboratory (LANL). A discrepancy was found, however, when we compared calculated values for the two bombs because a 1956 report by R.R. Wilson stated that sulfur acitvation by fast neutrons in Hiroshima was approximately three times greater than in Nagasaki. Our calculations based on Preeg's source-term data predicted about equal sulfur activation in the two cities.

31239 **(CONF-8710169—3) An overview of the IAEA Safety Series on procedures for evaluating the reliability of predictions made by environmental transfer models.** Hoffman, F.W.; Hofer, E. (Oak Ridge National Lab., TN (USA); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Oct 1987. Contract AC05-84OR21400. 14p.

From Workshop on methods for assessing the reliability of environmental transfer models predictions; Athens, Greece (5 Oct 1987).

The International Atomic Energy Agency is preparing a Safety Series publication on practical approaches for evaluating the reliability of the predictions made by environmental radiological assessment models. This publication identifies factors that affect the reliability of these predictions and discusses methods for quantifying uncertainty. Emphasis is placed on understanding the quantity of interest specified by the assessment question and distinguishing between stochastic variability and lack of knowledge about either the true value or the true distribution of values for quantity of interest. Among the many approaches discussed, model testing using independent data sets (model validation) is considered the best method for evaluating the accuracy in model predictions. Analytical and numerical methods for propagating the uncertainties in model parameters are presented and the strengths and weaknesses of model intercomparison exercises are also discussed. It is recognized that subjective judgment is employed throughout the entire modelling process, and quantitative reliability statements must be subjectively obtained when models are applied to different situations from those under which they have been tested. (6 refs.)

31240 **(DOE/ER/60521—T1) Biological effects of DNA repair, including mutagenesis: Progress report for the period June 1, 1987-March 31, 1988.** Hutchinson, F. (Yale Univ., New Haven, CT (USA). Dept. of Molecular Biophysics and Biochemistry). Apr 1988. Contract FG02-87ER60521. 6p. NTIS, PC A02/MF A01. Order Number DE88008359/JAW.

A study shows the effects of gamma radiation on inducing gross rearrangements in the DNA of mammalian cells in culture is described. A line of CHO cells, K1-X3/5, in which most or all of the single copy of the endogenous hprt gene on the X chromosome has been deleted was used. Various transformed cell lines have been made in which a single copy of the E. coli gpt gene has been stably incorporated into the chromosome. These cell were irradiated with gamma rays, and gpt mutants isolated by the same procedures routinely used to isolate hprt mutants. Those mutants that contain DNA with altered Southern blots are assumed to have gross rearrangements in the DNA.

31241 **(DOE/ER/60540—T1) [Mechanisms involved in the induction of radiation transformation in vitro]: Technical progress report.** (Harvard Univ., Cambridge, MA (USA)). 1987. Contract FG02-87ER60540. 3p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007055/JAW.

Experiments have now been completed designed to investigate the RBE for the induction of mutations in human cells by low

dose-rate exposure to Pu-Be neutrons. Continuous exposure of human lymphoblastoid cells over periods of 5 to 20 days resulted in a markedly enhanced mutation frequency at two genetic loci overthat observed when comparable doses of neutrons were administered in a period of a few hours. Results are now available from a total of 148 thymidine kinase mutant clones induced by exposure to x-rays, fast neutrons or Argon-40 ions. The molecular structural of changes at the active tk allele were detected by the use of a SacI restriction fragment length polymorphism and Southern blotting. 1 ref.

31242 **(DOE/EV/70118—T2) Environmental damage in human lymphocytes: Final report, January 1, 1983-September 30, 1986.** Norman, A. (California Univ., Los Angeles (USA)). 1986. Contract AS03-76EV70118. 10p.

Our overall objectives have been to develop better assays for chromosome damage in human populations and to use these assays in order to gain a deeper understanding of the sources of that damage. Our primary emphasis recently has been on the micronucleus (MN) assay in peripheral blood lymphocytes because it provides a relatively simple, rapid and reliable measure of chromosome damage. Perhaps our most important accomplishments have been to demonstrate that fact, to improve the assay by controlling for cell division, to demonstrate the feasibility of automating the assay, and to apply it to an investigation of theeffects of low level radiation exposure.

31243 **(GSF—14/87) Construction of an ultrasoft X-ray source - investigations with a view to the irradiation of biological objects.** Thurn, I. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Frankfurt am Main (Germany, F.R.). Abt. fuer Biophysikalische Strahlenforschung). Jun 1987. 104p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753541/JAW.

Beam guidance in the X-ray source (0.3 keV to 10 keV) takes place by means of pair of quadrupole lenses. The characteristic radiation was generated using C, Al, and Cu targets, and the beam was guided by a monitor system. An energy dose rate of 5 Gy/min was reached. This is sufficient for mammal cells as well as for bacteria.

31244 **(GSF-BPT—1/87) Study into the effects of UV-B radiation on small aquatic animals. Final report.** Siebeck, O.; Boehm, U. (Muenchen Univ. (Germany, F.R.). Zoologisches Inst.). (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften; Muenchen Univ. (Germany, F.R.). Zoologisches Inst.). 1987. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753544/JAW.

Small aquatic animals (daphinia, reef coral) have been tested for their UV light tolerance. The LD-50 is most probably dependent of the habitat: Animals living in shallow waters tolerate higher UV radiation doses than those living in deep water. Significant differences in tolerance are detectable only when UV-Birradiation (max. effects at 280 nm) is accompanied or followed by visible short-wave irradiation (max. effects: 410-460 nm). The report presents a comparison for orientation of the UV-B tolerance determined in a field study under the impact of global radiation with and without exclusion of the UV radiation, and of a laboratory study for which artifical UV-B sources have been used. Several types of crustaceans and reef corals have been studied in these experiments. The report then explains a comparative analysis of the shallow waters animal Daphnia pulex obtusa, and of the seawater animal Daphina galeata, both exposed to monochromatic radiation. (orig./KG) With 37 refs., 8 tabs., 17 figs..

31245 **(IC—87/207) Fluid and mass transport in a single lymphatic blood vessel.** Bestman, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702655/JAW.

The problem considers the single blood vessel model in pulmonary circulation in the presence of gravitation and mass transfer. The tissue surrounding the blood vessel is modelled as a permeable medium distinct from the blood vessel which is a normal free space. On the assumption that the mass concentration varies slowly at the interface between the blood vessel and the tissue, the problem is tackled by asymptotic approximation. A crucial point of the analysis is the dependence of the flow variables on the permeability K of the tissue in a completely arbitrary manner. A primary conjecture of the study is the intimacy of the pathological pulmonary edema and the parameter K. (author). 4 refs.

31246 **(INIS-BR—1077) Method of absorved dose calculation of biological distribution of a radionuclide.** Silva, A. dos A.P. da. (Santa Maria Univ. (Brazil). Dept. de Fisica). 1984. 25p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702775/JAW.

The method recommended by the International Commission on Radiation Units and Measurements (ICRU) for absorved dose calculation of a radionuclide distributed in a body is presented. The distance of a source point is estimated by the concept of specific isotropic point of absorved fraction. The ICRU method is compared with the traditional one for dose calculation-the gamma ray. (M.A.C.).

31247 **(INIS-mf—11690) Structural investigations by X-ray and neutron diffraction in biological membranes.** Mischel, M. (Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik). 28 Apr 1986. 134p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753550/JAW.

The molecular structure of biomembranes is investigated with phosphatidyl-glycerole and porine X-ray diffraction and neutron diffraction. Mathematical models for the ultrastructure of membranes are established.

31248 **(LBL—24885) Reaction analogues in the radiation-induced deamination and dephosphorylation of bio-organic molecules 2: Oxygenated solutions.** Garrison, W.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 12p.

The OH-induced deamination and dephosphorylation of simple peptides and phosphate esters in oxygenated solutions involve the fomation and subsequent degradation of the perodyl radicals RCONHC({dot O})R_3 and {bigcirc←P} OC({dot O})$_2$$R_2$ respectively. Reaction analogues in the degradation of peroxyl and alkoxyl radicals in these two systems are evaluated with reference to the OH-induced main-chain cleavage of protein and DNA. 25 refs.

31249 **(LUSG-WP—483) 'Pedigree' of radiation estimates: an exploratory analysis in the context of exposures of young people in Seascale as a result of Sellafield discharges.** Macgill, S.M.; Funtowicz, S.O. (Leeds Univ. (UK). School of Geography). Jun 1987. 22p. British Library, Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

This paper describes part of a new notational system - a pedigree coding - for representing the nature and significance of particular sources of imperfection afflicting the production of quantitative estimates. The pedigree coding is applied to the case of estimating radiation exposure of young people in Seascale as a result of Sellafield discharges. Empirical codings, resulting from interviews with relevant specialists, are shown to provide a cogent way of summarising critical sources of imperfection, this in turn giving crucial clues about the way related quantitative estimates should be communicated and interpreted. Lines for further development and application of the pedigree coding system are suggested.

31250 **(NUREG/CR—5067) Early and continuing effects of combined alpha and beta irradiation of the lung:.** Scott, B.R.;Hahn, F.F.;Snipes, M.B.;Newton, G.J.;Eidson, A.F.;Mauderly, J.L.;Boecker, B.B. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). Mar 1988. Contract AC04-76EV01013. 65p. (LMF—119). NTIS, PC A04/MF A01. Order Number TI88008165/JAW.

This report summarizes an inhalation exposure experiment that concerns early and continuing effects of combined alpha and

beta irradiation of the lung of rats. Both morbidity at 18 months and mortality within 18 months after exposure were examined for rats exposed to the beta-emitter ^{147}Pm, the alpha-emitter ^{238}Pu, or both combined. The results were used to validate hazard-function models that were developed (1)for pulmonary functional morbidity at 18 months and (2) for lethality from radiation pneumonitis and pulmonary fibrosis within 18 months. Both models were found to adequately predict the experimental observations after combined chronic alpha and beta irradiation of the lung. A relative biological effectiveness of approximately 7 was obtained for ^{238}Pu alpha radiation compared to ^{147}Pm beta radiation for both pulmonary functional morbidity and lethality from radiation pneumonitis and pulmonary fibrosis. 12 refs., 16 figs., 11 tabs.

31251 **(PNL—6490) Performance testing of radiobioassay laboratories: In vitro measurements (urinalysis): Final report.** MacLellan, J.A.; Traub, R.J.; Fisher, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 109p.

This report provides results of the two-round nationwide in vitro bioassay intercomparison study. Conclusions were based on analyses by 35 bioassay laboratories of nearly 1400 artificial urine samples containing known quantities of radionuclides. The test radionuclides were H, ^{89}Sr, ^{238}Pu, ^{241}Am, ^{137}Cs, ^{60}Co, and natural uranium. The data reported included background count rates, total samples counts, counting times, counting efficiencies, sample yields, and estimated errrors of the determinations. The measurement data were evaluated according to statistical methods presented in the November 1985 version of the draft ANSI Standard N13.30. If a laboratory failed a performance test for any one of the three criteria, the laboratory was considered to have failed the test for that category. 22 refs., 18 figs., 14 tabs.

31252 **(PNL—6523) Investigation of fire at Council, Alaska: A release of approximately 3000 curies of tritium.** Jensen, G.A.; Martin, J.B. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1988. Contract AC06-76RL01830. 66p.

On September 6, 1987, about 6:00 a.m., a fire was discovered in the community building at Council, Alaska, where 12 radioluminescent (RL) light panels containing approximately 3000 Ci were stored. All of the tritium in the panels was released as a result of the fire. This report summarizes the recovery of the remains of the panels destroyed in the fire and investigations completed to evaluate the fire site for possible exposure of community residents or contamination by tritium release in the environment. Based on the analysis of urine samples obtained from individuals in the community and from Pacific Northwest Laboratory personnel participating in the recovery operation, no evidence of exposure to individuals was found. No tritium (above normal background) was found in water and vegetation samples obtained at various locations near the site. 12 figs., 3 tabs.

31253 **(SSA—1987-TS-8) 1986 Scientific works.** (Centre de Recherches du Service de Sante des Armees, 75 - Paris (France)). 1987. 270p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88753490/JAW.

Several themes of radiobiology emerged from this progress report. They are as follows: effects of neutrons, gamma radiation and mixed gamma-neutron radiation on various anatomical structures (nerve cells, germ cells); biological parameters (hemostasia); pathological changes (inflammation); chemical radioprotection (cysteamine); relationships between radioprotection and the essential fatty acid status; radio contamination therapy (DTPA).

31254 (SSA—1987-TS-8, pp 9-10) **Comparative effects of fast neutrons and gamma rays on dentate gyrus subgranular cells in the rabbit brain.** Gueneau, G.; Baille, V.; Sabattier, R.; Breteau, N.; Court, L. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

We present here two recent results: 1. The comparative effects of fast neutrons and gamma rays on dentate gyrus subgranular cells in the rabbit brain. 2. The fast neutrons irradiation of one rabbit cerebral hemisphere and the comparative histological study with the non irradiated hemisphere.

31255 (SSA—1987-TS-8, pp 11-12) **Hormonal and cellular factors affecting immature sertoli cells radiosensitivity in rat fetus.** Coffigny, H.; Court, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France); Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

Immature Sertoli cells population was studied after irradiation either in hypophysectomised (decapited) or in germ cell free foetus (busulfan treated embryo). Decapitation did not modify the 10 % reduction of immature Sertoli cells after 1.5 Gy irradiation. But, without germ cells, immature Sertoli cells were more radiosensitive.

31256 (SSA—1987-TS-8, pp 15-16) **Physical incapacitation in macacus cynomolgus after 15 gy irradiation.** Mestries, J.-C.; Lechevin, J.-M.; Court, L. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

In Cynomolgus monkey which followed an excertion test after a gamma irradiation at 15 Gy, the performances drastically decreased the first day of irradiation and a restoration was observed between the second and the fifth day. If the animal were overtrained before the irradiation of 15 Gy we observed a decrease of the physical incapacitation. In all subjects the performances collapsed after the fifth day during the evolution of gastro-intestinal syndrome.

31257 (SSA—1987-TS-8, pp 17-18) **Lesions induced in baboons by a N-gamma global irradiation (N/gamma = 5,5).** Mestries, J.-C.; Picard, G.; Leleu, C.; Neveux, Y.; Court, L. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

In baboons exposed to a N-gamma global irradiation (N/gamma = 5,5) at a dose of 6 Gy, it has been observed: - alterations of hemostasia parameters, - hemorrhagic lesions, such as submucous hematoma, visceral petechiae and tissular necrosis of colon which becomes a critical organ, - cutaneous lesions limited to the front face and lesions of extremities evoking a LYELL syndrom.

31258 (SSA—1987-TS-8, pp 21-22) **Transient suppression of the zymosan-induced chemiluminescence produced by bone marrow cells during a subcutaneous non-specific inflammation in the mouse.** Herodin, F.; Benichou, G. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

The bone marrow cells (BMC) from mice bearing a polyacrylamide microbead induced granuloma (Biogels P 4 and P 100) show a transient striking decrease of their chemiluminescence (CL) response to opsonized zymosan, with a minimum observed at the 24 /sup th/ hour. Bone marrow granulocytes represent the main chemiluminescence BMC compartment. Biogel P 4-treated mice, show at the 24/sup th/ hour a significantly decreased percentage of segmented bone marrow granulocytes (- 45 %, $p < 0.001$).

31259 (SSA—1987-TS-8, pp 25-26) **Interaction of a radioprotector: cysteamine, with phospholipidic model membranes.** Roman, V.; Fatome, M.; Berleur, F.; Vachon, A. (Centre de Recherche du Service de Sante des Armees, 92 - Clamart (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

Besides the observation of molecular systems, spin labeling techniques make possible a description of oxygen diffusion of concentration in lipid membranes. In such a system, cysteamine presents a dynamic interaction ruled by pH conditions, either with polar heads or acyl chains according to lipid thermic phases, and inhibits oxygen transport. These results allow improvements in lipo-

some cysteamine entrapment, and provide an original explanation to cellular hypoxia after cysteamine administration.

31260 (SSA—1987-TS-8, pp 27-28) **Essential fatty acids and radioprotection.** Bienvenu, P.; Fatome, M.; Kergonou, J.-F.; Ducousso, R. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

Presenting a short review of published literature and some experimental results, the authors exemplified possible relationships between radioprotection and the essential fatty acid status underlying eicosanoid generation capacity.

31261 (SSA—1987-TS-8, pp 29-30) **Rapid screening test for decorporative efficiency of a molecule.** Gerasimo, P.; Duserre, C.; Metivier, M. (Centre de Recherches du Service de Sante des Armees, 92 - Clamart (France); CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). 1987. (In French). NTIS (US Sales Only), PC A12/MF A01.

In 1986 Scientific works.

A test to evaluate decorporative efficiency of molecules was established. Numerous molecules were able to prevent the fixation of plutonium on skeleton, but their efficiency was always inferior to that of DTPA. For neptunium, DTPA alone was unable to improve elimination, but vitamin C plus DTPA reduced skeletal load.

31262 (TPR-NS—29-No.1, pp 49-57) **Radiation hormesis and nuclear safety.** Congdon, C.C. 1988. I. Order Number TI88000602/JAW.

In Nuclear Safety: Technical progress review, January-March 1988.

The term radiation hormesis is used to describe unexpected positive biological effects after very low doses of ionizing radiation. In rodents, these effects include slight increases in median life span and increased body weight. Accelerated germination of seeds and increased plant growth also occur. In bacteria, a reported optimal growth occurs when the bacteria receive 0.05 to 0.1 Gy/h (5 to 10 rad/h). Reduced growth of bacteria has been attributed to an ionizing radiation deficiency. Many radiation biologists assume that these effects of low-level irradiation are based on excess repair or adaptation to minimal injury. Another thesis is that a direct stimulation of growth is produced by minimal ionizing radiation. Some investigators even theorize that radiation is essential for life. In toxicology and pharmacology, similar stimulation of biological systems by sublethal and minimal doses of poisonous substances has been known for many years as the Arndt-Schulz Law or Hueppe Rule. This overview includes the opinions on radiation hormesis of speakers at the Conference on Radiation Hormesis held in Oakland, California, in 1985. 23 references.

31263 (UCRL—53805) **Enjebi Island dose assessment.** Robison, W.L.;Conrado, C.L.;Phillips, W.A. (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 56p.

We have updeated the radiological dose assessment for Enjebi Island at Enewetak Atoll using data derived from analysis of food crops grown on Enjebi. This is a much more precise assessment of potential doses to people resettling Enjebi Island than the 1980 assessment in which there were no data available from food crops on Enjebi. Details of the methods and data used to evaluate each exposure pathway are presented. The terrestrial food chain is the most significant potential exposure pathway and ^{137}Cs is the radionuclide responsible for most of the estimated dose over the next 50 y. The doses are calculated assuming a resettlement date of 1990. The average wholebody maximum annual estimated dose equivalent derived using our diet model is 166 mremy;the effective dose equivalent is 169 mremy. The estimated 30-, 50-, and 70-y integral wholebody dose equivalents are 3.5 rem, 5.1 rem, and 6.2 rem, respectively. Bone-marrow dose equivalents are only slightly higher than the whole-body estimates in each case. The bone-surface cells (endosteal cells) receive the highest dose, but they are a less sensitive cell population and are less sensitive to fatal cancer induction than whole body and bone marrow. The effective dose equivalents for 30, 50, and 70 y are 3.6 rem, 5.3 rem, and 6.6 rem, respectively. 79 refs., 17 figs., 24 tabs.

31264 **Absorption of ^{233}U, ^{237}Np, ^{238}Pu, ^{241}Am and ^{244}Cm from the gastrointestinal tracts of rats fed an iron-deficient diet.** Sullivan, M.F.; Ruemmler, P.S. (Pacific Northwest Lab., Richland, WA (USA)). *Health Physics;* **54**: No. 3, 311-316(Mar 1988).

Absorption of U, Np, Am and Cm was increased by factors of 3.4, 7.1, 2.7 and 1.7, respectively, when nitrate solutions of these actinides were gavaged to adult rats fed an iron-deficient diet. Retention increased proportionately in liver, kidney and carcass. The concentration of the actinides excreted also increased substantially (over that of controls) in the urine of iron-deficient rats gavaged with ^{233}U and ^{237}Np, but not in those with ^{241}Am or ^{244}Cm. Weanling rats on an iron-deficient diet, gavaged with ferric nitrate immediately before administration of ^{238}Pu nitrate, retained between 4% and 12% of the ^{238}Pu retained by litter mates that were not treated intragastrically with iron.

31265 **What is a low dose of radiation?.** Bond, V.P.;Booz, J.;Feinendegen, L.E. (Brookhaven National Lab., Upton, NY (USA);Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* **53**: No. 1, 1-12(Jan 1988). (CONF-8705273—). Contract AC02-76CH00016.

From Workshop on low dose radiation and the immune system; Dreieich-Frankfurt, F.R. Germany (5 May 1987).

The point made is that, although absorbed organ dose is a useful quantity with high-level exposure, e.g. radiotherapy, it may be misleading if applied alone to low-level exposure, and to single cell-originating responses, because absorbed dose is a composite variable. Microdosimetric techniques permit decoupling of components, avoiding confusion. Decoupling absorbed dose components means that a complete description of LLE and HLE must include more than one separate and independent variable. For LLE, the elemental dose (Z_1) must be small (assured by using a low-LET radiation), and the hazard potential of the radiation field must be kept low. For HLE to a low-LET radiation, not only must the exposure be large enough to ensure that z-bar will have a small variance, but exposure time must be short to minimize the effect of repair mechanisms. If the HLE is to a high-LET radiation, the above specifications obtain except it is less important that t be kept small. (U.K.).

31266 **Effect of low-dose irradiation on unstimulated and PHA-stimulated human lymphocyte subsets.** Stewart, C.C.;Stevenson, A.P.;Habbersett, R.C. (Los Alamos National Lab., NM (USA)). *International Journal of Radiation Biology and Related Studies in Physics, Chemistry and Medicine;* **53**: No. 1, 77-87(Jan 1988). (CONF-8705273—).

From Workshop on low dose radiation and the immune system; Dreieich-Frankfurt, F.R. Germany (5 May 1987).

A culture system was used to evaluate the radiosensitivity of CD 4^+ and CD 8^+ T cells, Leu 19^+ cells, and B cells obtained from normal adult males. Unstimulated CD 8^+ lymphocytes (D_0 = 55 cGy). B cells had an intermediate radiosensitivity (D_0 = 100 cGy). Leu 19^+ cells were much more radioresistant and expressed a D_0 of 550 cGy. When lymphoid cells were irradiated 1 or 4 days before phytohemagglutinin (PHA) stimulation, they were more radiosensitive than if they were first stimulated with PHA and then irradiated. When lymphoid cells were irradiated 1 h after PHA stimulation each lymphocyte subset was characterized by an increase in the D_0 to 150 cGy for B cells to 290 cGy for $CD4^+$ cells, and to 240 cGy for $CD8^+$ cells. In contrast, Leu 19^+ cells exhibited a decrease in their D_0 to 290 cGy after they were stimulated by PHA.

31267 **Ionizing radiations and their interactions with matter.** Sholtis, J.A. Jr. (Air Force Element, Headquarters, Dept. of Energy, Defense Energy Projects, Washington, DC 20545). pp 55-86 of Military radiobiology. Conklin, J.J.; Walker, R.I. Orlando, FL; Academic Press Inc. (1987).

When a nuclear weapon detonates, a tremendous amount of energy is promptly released in the form of ionizing radiation. This radiation, composed of both electromagnetic and particulate forms, predominantly includes alpha particles, beta particles, positrons, neutrons, X rays, gamma rays, and fission fragments. The ways in which these individual radiation types interact with matter in the

environment determine (along with the radiation amount, of course) the actual hazard that is presented. These interaction mechanisms also offer insights into methods that can be used to detect and measure the radiation as well as reduce the biological hazard. In this chapter a practical summary of protection and shielding is included as a distinct subsection for each radiation type discussed.

31268 Dependence of skeletal ^{212}Pb retention on bone surface-to-volume ratio following ^{224}Ra intake. Schlenker, R.A. (Argonne National Lab., IL (USA)). *Radiation Protection Dosimetry;* 20: No. 3, 135-142(1987). Contract W-31-109-ENG-38.

Theory predicts that the ratio of ^{212}Pb to ^{224}Ra activity in the skeleton and the reciprocal bone surface-to-volume $[(SV)]^{-1}$ ratio are related by an equation of the form $^{212}Pb^{224}Ra = a + b(SV)^{-1}$. The prediction is verified for rat bone epiphyses where $^{212}Pb^{224}Ra = 0.54 + 54.7(SV)^{-1}$ and for mouse, rat, and dog skeletons, where $^{212}Pb^{224}Ra = 0.52 + 43.9(SV)^{-1}$ as determined by least square fitting the general function to experimental data. This dependence shows that retention assumptions for ^{224}Ra daughter products made when calculating the skeletal doses for children who developed bone cancer following ^{224}Ra therapy should be varied with age to reflect the age dependence of bone surface-to-volume ratio. A dependence of skeletal lead-to-radium ratio on $(SV)^{-1}$ should also occur for the ^{228}Th, ^{223}Ra, and ^{225}Ra decay series.

31269 The critical cell concept and its application in the assessment of effects from different dose rates and different radiation qualities. Feinendegen, L.E.; Bond, V.P.; Sondhaus, C.A. (Institute of Medicine, Nuclear Research Center Julich GMBH, D-5170 Julich). pp 211-220 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—).

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The question of radiation effects from ^{3}H and other radionuclides incorporated into the genetic material inevitably arose. Committee 24 of the National Council on Radiation Protection (NCRP), on which the senior author has served, was set up to work out guidelines for the use of radiation protection dosimetry in the incorporation of [^{3}H]TdR. How was one to proceed with the problem of detriment generated by radionuclides that were heterogeneously distributed within a fraction of proliferating cells, or were eventually distributed among resting cells? After long deliberation, the question was finally addressed in NCRP Report 63; in the process, this effort helped to advance a new concept of absorbed dose and its consequences with respect to late effects. It was becoming increasingly clear at this time, from microdosimetric and other considerations, that the conventional concept of dose was inapplicable in the case of low-dose exposure. In discussing this problem, the authors briefly deal with the following three questions: (a) In the case of low-dose exposures, what and how big is the apparent critical volume of the individual cell "target" which gives rise to late effects such as cancer? (b) What is the fate of this critical volume in the low-dose-exposure case? (c) How does this critical volume react to being hit by different-sized energy packages, or "hit sizes"?

31270 Cytogenetic assessment of radiation effects in lymphocytes of individuals accidentally exposed to ^{60}Co gamma rays. DuFrain, R.J.; Littlefield, L.G.; Joiner, E.E.; Hubner, K.F.; Maisterrena, J.F. (Radiation Emergency Assistance Center/Training Site, Oak Ridge Associated Universities, Oak Ridge, TN 37831). pp 67 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC05-76OR00033.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Ten individuals involved in a ^{60}Co contamination accident in Juarez, Mexico were evaluated for possible radiation, exposures by cytogenetic assessment of blood lymphocytes for structural chromosome aberrations. This assay confirmed significant exposures in at least 8 of the 10. Additional cytogenetic assays were performed on the blood cells from several of the individuals. Sister chromatid exchange (SCE) frequencies were determined in 2-day and 3-day cultures. The 3-day cultures were also evaluated for micronucleus frequency, mitotic index, and proliferation kinetics. From these studies the authors determined that the micronucleus test is sufficient for rapid screening, but we could not compare its accuracy with conventional aberration analysis because of the lack of physical dosimetry. The SCE frequencies did not correlate with the aberration data or the micronucleus data, which confirms their previous findings that SCEs in human lymphocytes are not useful in biological dosimetry following in vivo exposures to ionizing radiation.

31271 Modulation of radiation-induced hemopoietic suppression by acute thrombocytopenia. Ebbe, S.; Phalen, E.; Threatte, G.; Londe, H. (Donner Lab., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 179-189 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—). Contract AC03-76SF00098.

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

Previous studies have shown that the thrombocytopoietic suppression induced in mice by sublethal doses of radiation could be modified by production of acute thrombocytopenia with heterologous anti-mouse platelet serum (APS) at the time of exposure to radiation. For 4 days after irradiation, mice maintain normal platelet counts; during this interval, recovery to about normal platelet counts occurs from superimposed immunothrombocytopenia. Thereafter, platelet counts decline from the effects of the radiation. However, the radiation-induced thrombocytopenia is neither as severe nor as prolonged in mice that are initially treated with APS as it is in mice that are just irradiated. The present studies were done to further characterize the hemopoietic response to radiation and APS and to determine the effect of acutely reducing the platelet count with the nonimmunological agent neuraminidase (N'ase).

31272 Enhanced proliferation of transfused marrow and reversal of normal growth inhibition of female marrow in male hosts 2 months after sublethal irradiation. Brecher, G.; Mulcahy, K.; Tjio, J.H.; Raveche, E. (Donner Lab., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 232-238 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—). Contract AC03-76SF00098.

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

It is well established that 0.5 to 1 million marrow cells suffice to rescue (though not necessarily fully restore) lethally irradiated mice, while even 40 million cells result only in minimal seeding in isogeneic, nonirradiated mice. It was originally suggested that the results imply the existence of special proliferative sites which are filled in the nonirradiated animal, but are emptied by high doses of irradiation. In 1982 the authors demonstrated the feasibility of establishing substantial numbers of donor cells in normal, non-irradiated hosts. After four daily transfusions of 50 million marrow cells, 20-40% of the host's marrow consisted of cells of donor origin. The present paper reports the marked enhancement of the proliferation of transfused marrow cells in mice exposed to sublethal doses of irradiation of 300-900 R. Two months later, when the peripheral blood counts of the irradiated animals had returned to normal, transfusion of 100 million cells resulted in donor cell percentages of 55-100% in the peripheral blood and marrow. The authors previously found that male donor cells proliferated as readily in female as in male hosts, while female donor cells proliferated to a comparable degree only in female hosts. In the present study, male animals that had been exposed to 600-900 R 2 months earlier sustained proliferation of male and female donor cells equally well.

31273 Neon-20 ion- and x-ray-induced mammary carcinogenesis in female rats. Shellabarger, C.J.; Baum, J.W.; Holtzman, S.; Stone, J.P. (Medical Dept. and Safety and Environmental Protection Div., Brookhaven National Lab., Upton, NY 11973). pp 239-244 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—). Contract AC02-76CH00016.

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The acceleration of heavy ions ($^{12}_{6}C$, $^{20}_{10}Ne$, $^{40}_{18}Ar$) to energies of 400-500 MeVamμq has been achieved at the BEVALAC of the University of California in Berkeley. In addition to radiation therapy, one of the proposed uses of heavy-ion irradiation is to image lesions of the human female breast. It is now generally accepted that radiation exposure of the human female breast will increase the risk of breast cancer development. It is known that radiation-induced mammary carcinogenesis in the female rat occurs by a scopal mechanism that is similar to the scopal mechanism of radiation-induced breast cancer in the human female. Thus, the rat model system was chosen to assess the carcinogenic potential of heavy-ion irradiation in the belief that data obtained from rat studies would have a qualitatively predictive value for the human female. Accordingly, female rats were exposed to ^{20}Ne ions at the BEVALAC and studied for the development of mammary neoplasia for 312 +- 2 days at Brookhaven National Laboratory along with rats exposed concurrently to X irradiation or to no irradiation.

31274 Effect of iron on plutonium absorption by the adult or neonatal rat. Sullivan, M.F.; Ruemmler, P.S. (Biology and Chemistry Dept., Pacific Northwest Lab., Richland, WA 99352). pp 73 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Plutonium absorption is higher in iron-deficient adult rats than in controls. Since plutonium has also been reported to bind iron carrier proteins, large amounts of iron may inhibit plutonium transport. To test that effect, iron powder or ferric iron was administered intragastrically along with ^{238}Pu nitrate, andor iron dextran was injected i.m. before gavage. Ferric iron increased absorption of ^{238}Pu by fasted rats by an order of magnitude, but that increases was less when iron dextran was injected before the ferric iron and ^{238}Pu gavage. Intragastrically administered iron powder decreases absorption to less than the value for rats fed ad lib., suggesting that, in adult animals, absorption may be influenced by a redox effect on plutonium or on the intestinal mucosa. Suckling rats absorbed approximately 100 times more plutonium than adults, presumably because of intestinal permeability. Injections of iron dextran decreased absorption in that age group, but gavage with e4ither ferrous or ferric iron almost completely blocked ^{238}Pu absorption. That suggests that intenstinal permeability may not be the major reason for the high absorption in neonates. It also suggests that the iron deficiencies often reported for neonates, including humans, may be an important factor in neonatal toxicity that has not been considered previously.

31275 The Tritium Toxicity Program in the medical department at Brookhaven National Laboratory. Carsten, A.L. (Medical Research Center, Brookhaven National Lab., Upton, NY 11973). pp 258-268 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—). Contract AC02-76CH00016.

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The initial concept in establishing the TRITOX program, which began in 1971 and is still active today, was to examine primarily one particular question: "What might be the genetic hazard (as measured by the dominant lethal mutation test) of continued exposure to tritiated water (HTO) at levels approximately 100 times the maximum permissible concentration (3.0 μCi/ml)?" In order to answer this question, it was necessary to establish a rather large monitored tritium facility and a mouse colony for breeding and maintaining a large number of animals on the HTO regimen. It also became evident that there were many unanswered questions concerning the many possible effects of HTO ingestion. Therefore, over the ensuing years a multiparameter examination of somatic, genetic, and cytogenetic effects, as well as questions related to biochemistry and dosimetry resulting from continuous maintenance on an HTO regime, was undertaken.

31276 Structures of DNA containing psoralen crosslink and thymine dimer. Kim, S.H.; Pearlman, D.A.; Holbrook, S.R.; Pirkle, D. (Dept. of Chemistry and Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720 (USA)). pp 143-152 of Molecular basis of cancer. Rein, R. New York, NY; Alan R. Liss Inc. (1985). (CONF-8405214—).

From Molecular basis of cancer conference; Buffalo, NY, USA (29 May 1984).

UV irradiation by itself or in conjunction with other chemicals can cause covalent damages to DNA in living cells. To overcome the detrimental effect of DNA damage, cells developed a repair mechanism by which damaged DNA is repaired. In the absence of such repair, cell malfunction or cell death can occur. Two most studied radiation-induced DNA damage are thymine dimer formation by UV irradiation and psoralen crosslink by combination of psoralens and UV: In the former, two adjacent thymine bases on a strand of DNA are fused by forming cyclobutane ring, and in the latter, one pyrimidine on one DNA strand is crosslinked to another pyrimidine on the other strand via a psoralen. The authors' objective is to deduce the structure of DNA segment which contains a psoralen crosslink or a thymine dimer using the combination of results of X-ray crystallographic studies, molecular model building, and energy minimization. These structural features may be important for understanding the biological effects of such damages and for the recognition by the repair enzymes.

5602 Thermal Effects

31277 (PNL—6492) Environmental assessment of the potential effects of aquifer thermal energy storage systems on microorganisms in groundwater. Hicks, R.J.; Stewart, D.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1988. Contract AC06-76RL01830. 65p.

The primary objective of this study was to evaluate the potential environmental effects (both adverse and beneficials) of aquifer thermal energy storage (ATES) technology pertaining to microbial communities indigenous to subsurface environments (i.e., aquifers) and the propagation, movement, and potential release of pathogenic microorganisms (specifically, Legionella) within ATES systems. Seasonal storage of thermal energy in aquifers shows great promise to reduce peak demand; reduce electric utility load problems; contribute to establishing favorable economics for district heating and cooling systems; and reduce pollution from extraction, refining, and combustion of fossil fuels. However, concerns that the widespread implementation of this technology may have adverse effects on biological systems indigeneous to aquifers, as well as help to propagate and release pathogenic organisms that enter thee environments need to be resolved. 101 refs., 2 tabs.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 29875, 29915, 30187, 31148, 31190, 31216, 31276, 31364

31278 (BNL—40629-Vol.1) Kosova coal gasification plant health effects study: Volume 1, Summary. Morris, S.C.; Jackson, J.O.; Haxhiu, M.A. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 37p.

This is the summary volume of a three-volume report of the Kosova coal gasification plant health effects study. The plant is of the Lurgi type and began commercial operation in 1971. The study was conducted under the auspices of the U.S.-Yugoslav Joint Board for Scientific and Technological Cooperation. It had five overall purposes: (1) Identify potential health risks in the gasification plant and provide information on possible control measures. (2) Use the experience in Kosova as a basis of judging potential health risks and

avoiding potential problems at future commercial scale gasification plants in the United States and Yuogoslavia. (3) Acquire information on industrial hygiene practices at an operating commercial scale coal gasification plant. (4) Use the experience in Kosova to contribute to understanding dose-response relationships of exposure to complex organic mixtures. (5) Increase the scientific capabilities of scientists in Kosova in the areas of epidemiology and industrial hygiene. This report introduced the Kosova gasification plant and the study design and summarizes the preliminary studies of 1981 to 1983, the detailed characterization campaign of 1984, the retrospective epidemiology study, ongoing clinical studies, and the successful technology transfer. It presents conclusions and recommendations from the industrial hygiene and epidemiology studies. 18 refs.

31279 (CONF-870940—4) Persistence of urinary excretion products of benzo(a)pyrene. Uziel, M.; Haglund, R.; White, D.A. (Oak Ridge National Lab., TN (USA); Texas Univ., Houston (USA). School of Public Health). 1988. Contract AC05-84OR21400. 16p.

From 11. international symposium on polynuclear aromatic hydrocarbons; Gaithersburg, MD, USA (23 Sep 1987).

Persistence of DNA-adducts has been observed in a variety of experimental circumstances and has been suggested as one potential mechanism for explaining the long-term delay before expression of proliferative disease. In this concept, a stable DNA-adduct, which is a remnant of a prior exposure in a nondividing cell, would not express the genotoxic effect until the cells were stimulated to divide, and thus explain the long-term delay in expression of cancer. An alternative view of the observation of persistent DNA-adducts, described in this communication, is the continuing replenishment of DNA adducts by formation and turnover of these adducts from exposure to a constant supply of the ultimate carcinogenic species derived from a prior exposure. It is of interest to note that virtually all experiments where "persistent" adducts have been observed have been high dose exposures. During the course of experiments designed to develop improved methods for detection of DNA adducts and related derivatives derived from polynuclear aromatic hydrocarbons (PAH), we observed that there was a continuous excretion of urinary derivatives of the injected benzo(a)pyrene (BaP) beyond the initial burst of detoxification. This report describes the time dependent distribution of those derivatives in blood, urine, feces, and at the site of injection. 11 refs., 5 figs., 4 tabs.

31280 (DOE/ER/60015—3) [Carcinogen-DNA adducts: Linkage site and conformation]: Progress report, September 1, 1984-June 30, 1987. Broyde, S. (New York Univ., NY (USA). Dept. of Biology). [1987]. Contract AC02-81ER60015. 36p.

We now have a reliable program for computing single stranded and duplex structures of carcinogen-modified DNA's to the dodecamer level, and are beginning to understand the conformational effects that polycyclic aromatic amines and hydrocarbons impose om modified DNA. A hypothesis relating mutagenicity and conformation has in fact emerged directly from the calculations. In addition, work has begun on a new program which permits flexibility in bond lengths and bond angles, and that employs novel minimization approaches. The reactive precursors to aromatic amine-DNA adducts are hydroxamic acid esters from which it is believed that nitrenium ions are produced. This reaction has been successfully applied to the production of several acetylaminofluroene (AAF) adducts from N-acetoxyacetylaminofluorene (AAAF). However, when we used identical conditiosn in attempts to prepare the corresponding acetylaminobiphenyl adducts, absolutlely no product, was isolated. This led to a re-examination of the mechanism of these reactions. We have prepared a deoxydinucleoside monophosphate containing the major adduct derived from the carcinogenic amine 4-aminobiphenyl and analyzed its conformation by theoretical and experimental methods. Reaction of d(CpG) with N-acetoxy-N-(trifluoracetyl)-4-aminobiphenyl afforded the product modified at C-8 of guanine with 4-aminobiphenyl. After purification by reverse-phase high-performance liquid chromatography, milligram amounts of product were obtained. It was analyzed by circular dichroism, proton magnetic resonance, and minimized potential-energy calculations. 11 figs., 3 tabs.

31281 (DP-MS—84-10) Carbon dioxide exchange and growth of a pine plantation. Murphy, C.E. Jr. (Savannah River Lab., Aiken, SC (USA)). 1981. Contract AC09-76SR00001. 44p.

The exchange of materials between the atmosphere and terrestrial ecosystem is important to an understanding of the cycling of essential elements, the deposition of mateials from the atmosphere and the entrance of pollutants into the forest ecosystems. This paper reports the results of measurements of carbon dioxide exchange in a vigorously growing pine plantation. Measurement data were incorporated into a model used to estimate annual carbon dioxide exchange and measured annual biomass accumulation in the same plantation were used to determine a carbon dioxide to biomass conversion efficiency. Carbon dioxide exchange was 10.5 metric tons per hectare and biomass accumulation was 4.5 metric tons per hectare. The conversion efficiency of cabon dioxide to biomass is about 25% less than the theoretical chemical conversion efficiency. 27 refs., 8 figs.

31282 (PB—88-170709/XAB) Absorption and biokinetics of U in rats following an oral administration of uranyl nitrate solution. La Touche, Y.D.; Willis, D.L.; Dawydiak, O.I. (Oregon State Univ., Corvallis (USA). Dept. of General Science). 1987. 19p. NTIS, PC A03/MF A01.

Pub. in Health Physics, Vol. 53, No. 2, 147-162(Aug 1987).

The absorption of Uranyl (U) within the male Wistar rat was determined following oral gavage with uranyl nitrate solutions at seven different dosages. Gavage levels ranged from 0.003 to 45 mg U per kilogram body weight. Uranium tissue burdens were determined at 0.25, 0.5, 1, 2, 4, 8, 24, 48, 96 and 240 h following gavage. Blood, kidney, liver, and bone were analyzed for U content using neutron activation followed by delayed-neutron counting. Uranium rapidly localized in the kidneys and bone following ingestion. Bone was found to be the primary tissue of deposition. Skeletal and kidney burdens closely paralleled each other from 15 min to 10 d after oral gavage. Uranium burdens in the blood reached a maximum within 30 min but declined rapidly thereafter. Burdens of all tissues were well correlated with each other and with dosage at all dose levels. Equations relating body burdens with blood levels were developed and found to be useful for predicting body burdens for the initial 8 h following gavage. Gastrointestinal absorption (F1) was 0.6-2.8% over the range of U administered. Movement of U through the GI tract was assessed at two dosages. The transit time of U through the GI tract was approximately 48 h. Uranium loss from the stomach was described as a power function of time. The maximum value in the small intestine was attained within 2 h, and thereafter its rapid loss was linear up to 8 h. A minor residual loss component from the small intestine was evident beyond 8 h post-gavage.

31283 (PB—88-171103/XAB) Effect of nickel and cadmium chloride on autonomic and behavioral thermoregulation in mice. Gordon, C.J.; Stead, A.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 12p. (EPA—600/J-86/449). NTIS, PC A03/MF A01.

Pub. in Neurotoxicology-7, No. 3, 97-106(1986).

Male BALB/c mice were injected intraperitoneally (i.p.) with nickel chloride (0, 5, 10, and 15 mg/kg) or cadmium chloride (0, 2, 4, and 6 mg/kg) while preferred ambient temperature (Ta) and activity were measured. Both metals caused drastic reductions in preferred Ta and activity within 30-min postinjection. Preferred Ta and activity were depressed for up to 90 min following nickel and cadmium injection. In a second experiment, body temperature was measured 60 min following the injection of nickel or cadmium chloride at a Ta of 20, 30, or 35 C. Nickel and cadmium caused a drastic reduction in body temperature when injected at a Ta of 20 and 30 C but produced either no effect or only a slight elevation in body temperature at a Ta of 35 C. In a third experiment, metabolic rate was measured continuously for 60 min following the i.p. injection of a relatively large dose of nickel (15 mg/kg) or cadmium chloride (6 mg/kg) at a Ta of 20, 30, and 35 C. Both metals caused significant reductions in metabolic rate at Ta's of 20 and 30 C.

31284 **(PB—88-171111/XAB) Effect of alcohol on behavioral and autonomic thermoregulation in mice.** Gordon, C.J.; Stead, A.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Alcohol, Vol. 3, 339-343(1986).

Male, BALB/c mice were injected intraperitoneally with ethyl alcohol (ethanol) in dosages of 0, 0.03, 0.1, 0.3, 1.0, or 3.0 g/kg and then placed in a temperature gradient that permitted the measurement of preferred ambient temperature (Ta). The 3 g/kg dosage of ethanol resulted in a slight lowering of the preferred Ta during the first 30 min of placement in the gradient. However, there was no overall statistically significant effect of alcohol dosage on preferred Ta. In another experiment, BALB/c mice were treated with the aforementioned ethanol dosages while metabolic rate (MR), evaporative water loss (EWL), and colonic temperature were measured 60 min post-injection at Ta's of 20, 30, and 35 C a dosage of 3 g/kg caused a significant decrease in MR, EWL, and colonic temperature. At a Ta of 30 C this same dosage caused significant reduction in colonic temperature, however; at Ta of 35 C ethanol had no effect on these parameters. In spite of the significant decrease in colonic temperature at a Ta of 30 C, which approximates the normal preferred Ta, the behavioral thermal preference was marginally affected. It is not clear whether or not ethanol injection results in a decrease in the set-point body temperature.

31285 **(PB—88-172374/XAB) Summary review of health effects associated with naphthalene: health issue assessment.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Nov 1987. 59p. (EPA—600/8-87/055F). NTIS, PC A04/MF A01.

Naphthalene is released into ambient air via industrial gaseous and particulate emissions, tobacco use, and through consumer use. The data base concerning exposure of humans via inhalation and associated health effects is virtually nonexistent. Overexposure often results in acute hemolytic anemia and has been associated with cataract formation. There are no available dose-response data. In laboratory animals, two principal target tissues have been identified: non-ciliated bronchiolar epithelial (Clara) cells and eye tissue. The metabolite(s) responsible for Clara cell damage is unknown. There are no published studies involving inhalation exposure. Administration of naphthalene by routes other than inhalation has been shown to produce cataracts in rats, rabbits, and one mouse strain. Animal strains with pigmented eyes develop cataracts faster and more severely than albino strains. The likely causative agent is polyphenol oxydase, found only in pigmented eyes, that catalyzes the formation of 1,2-naphthoquione which binds to lens tissue. Negative results have been reported for gene mutations (Salmonella), unscheduled DNA synthesis in rat hepatocytes and microneuclei in mouse bone marrow. Limited teratology studies in rats and rabbits reported no gross abnormalities. In a single dose (300 mg/kg) study in mice, both maternal and fetal toxicity were reported.

31286 **(PB—88-175880/XAB) Development of adrenergic receptor binding sites in brain regions of the neonatal rat: effects of prenatal or postnatal exposure to methylmercury.** Bartolome, J.V.; Kavlock, R.J.; Cowdery, T.; Orband-Miller, L.; Slotkin, T.A. (Duke Univ., Durham, NC (USA). Dept. of Pharmacology). 1987. 15p. NTIS, PC A03/MF A01.

Pub. in Neurotoxicology, Vol. 8, No. 1, 1-14(1987).

In order to understand the effects of developmental exposure to methylmercury on the ontogeny of synaptic function, the impact of prenatal or postnatal exposure on acquisition of receptor binding sites for norepinephrine was examined. The actions of the mercurial were both regionally - and receptor subtype-selective and depended upon the maturational profile of each region. Alpha 1 and alpha 2 and Beta-receptor sites in the cerebellum, the region which develops last, were the most vulnerable to methylmercury. In contrast, the same receptor subtypes in the midbrain + brainstem, which develops earliest, were resistant to methylmercury. The cerebal cortex, which matures at a time midway between cerebellum and midbrain + brainstem, also displayed intermediate vulnerability to actions of methylmercury on receptors. Within the cerebellum, prenatal exposure to 1 mg/kg to methylmercury, interfered the most with ontogeny of alpha 1-receptor binding, less so far alpha 2-receptors and least for Beta-receptors. Lower doses of methylmercury tended to increase receptor binding for all subtypes, a fact which may contribute to promotion of neurological development seen in animals exposed to those levels.

31287 **(PB—88-178710/XAB) Health-effects assessment for boron and compounds.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 40p. (EPA—600/8-88/021). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systematic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31288 **(PB—88-178728/XAB) Health-effects assessment for fully halogenated methanes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 44p. (EPA—600/8-88/041). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31289 **(PB—88-178736/XAB) Health-effects assessment for hexachloroethane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 32p. (EPA—600/8-88/043). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should

be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31290 **(PB—88-178744/XAB) Health and environmental-effects profile for 2-nitropropane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Apr 1985. 47p. (EPA—600/X-85/112). NTIS, PC A03/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for 2-nitropropane was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. 2-Nitropropane has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for 2-nitropropane is 9.36 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for 2-nitropropane is 1000.

31291 **(PB—88-178769/XAB) Health and environmental effects profile for 4,4'-methylenebis(n,n-dimethyl)aniline.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 63p. (EPA—600/X-85/371). NTIS, PC A04/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for 4,4'-methylenebis-(N,N-dimethyl)-aniline was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the REsource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. 4,4'-Methylenebis-(N,N-dimethyl)aniline has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for 4,4'-methylenebis-(N,N-dimethyl)aniline is .115 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for 4,4'-methylenebis-(N,N-dimethyl)aniline is 1000.

31292 **(PB—88-178777/XAB) Health and environmental-effects profile for dichloroethanes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Oct 1985. 148p. (EPA—600/X-85/359). NTIS, PC A07/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for dichloroethanes was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Dichloroethanes have been evaluated as a carcinogen. The human carcinogen potency factors (q1*) for 1,1-dichloroethane and 1,2-dichloroethane are .091 (mg/kg/day)-1 and .069-2 (mg/kg/day)-1, respectively, for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for 1,1- and 1,2-dichloroethane is 1000.

31293 **(PB—88-178785/XAB) Health and environmental effects profile for methyl methacrylate.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 88p. (EPA—600/X-85/364). NTIS, PC A05/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for methyl methacrylate was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Methyl methacrylate has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for methyl methacrylate is 5.3 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for methyl methacrylate is 1000.

31294 **(PB—88-178793/XAB) Health-effects assessment for 2,4- and 2,6-dinitrotoluene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 43p. (EPA—600/8-88/032). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, toxicants for which cancer is not the endpoint of concern. The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects

when exposure occurs during a limited time interval. The RfD is an estimate of an exposure lel that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31295 **(PB—88-178926/XAB) Health-effects assessment for tin and compounds.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 41p. (EPA—600/8-88/055). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systematic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31296 **(PB—88-178934/XAB) Health-effects assessment for selected phthalic acid esters.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Oct 1987. 80p. (EPA—600/8-88/053). NTIS, PC A05/MF A01.

See also PB—86-134111.

The report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision-making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31297 **(PB—88-178942/XAB) Health-effects assessment for 2-chlorophenol and 2,4-dichlorophenol.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 36p. (EPA—600/8-88/052). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systematic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31298 **(PB—88-178967/XAB) Health-effects assessment for nitrophenols.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 27p. (EPA—600/8-88/050). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31299 **(PB—88-178975/XAB) Health-effects assessment for nitrobenzene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 34p. (EPA—600/8-88/049). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31300 **(PB—88-179379/XAB) Health-effects assessment for dibenzofuran.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 26p. (EPA—600/8-88/026). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31301 **(PB—88-179387/XAB) Health-effects assessment for dichlorobenzenes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 58p. (EPA—600/8-88/028). NTIS, PC A04/MF A01.

See also PB—86-134111.

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31302 **(PB—88-179395/XAB) Health-effects assessment for creosote.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 27p. (EPA—600/8-88/025). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31303 **(PB—88-179403/XAB) Health-effects assessment for aldrin.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 39p. (EPA—600/8-88/015). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31304 **(PB—88-179411/XAB) Health-effects assessment for acrylonitrile.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 45p. (EPA—600/8-88/014). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31305 **(PB—88-179429/XAB) Health-effects assessment for aluminum.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 40p. (EPA—600/8-88/016). NTIS, PC A03/MF A01.

See also PB—86-134111.

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ated with specific chemicals or compounds. The Office of Emergency and Remedial Response (Superfund) uses these documents in preparing cost-benefit analyses under Executive Order 12991 for decision making under CERCLA. All estimates of acceptable intakes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31306 **(PB—88-179437/XAB) Health-effects assessment for ammonia.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 52p. (EPA—600/8-88/017). NTIS, PC A04/MF A01.

See also PB—86-134111.

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31307 **(PB—88-179445/XAB) Health-effects assessment for antimony and compounds.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 46p. (EPA—600/8-88/018). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31308 **(PB—88-179452/XAB) Health-effects assessment for benzidine.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 46p. (EPA—600/8-88/019). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31309 **(PB—88-179460/XAB) Health-effects assessment for beryllium and compounds.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 69p. (EPA—600/8-88/020). NTIS, PC A04/MF A01.

See also PB—86-134111.

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31310 **(PB—88-179478/XAB) Health-effects assessment for bromomethane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 34p. (EPA—600/8-88/022). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31311 **(PB—88-179486/XAB) Health-effects assessment for bis(2-chloroethyl)ether.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 28p. (EPA—600/8-88/023). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31312 **(PB—88-179494/XAB) Health-effects assessment for acrolein.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 37p. (EPA—600/8-88/013). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31313 **(PB—88-179502/XAB) Health-effects assessment for acetonitrile.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 39p. (EPA—600/8-88/012). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31314 **(PB—88-179510/XAB) Health-effects assessment for acenaphthylene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 24p. (EPA—600/8-88/011). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31315 **(PB—88-179528/XAB) Health-effects assessment for n-pentane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 22p. (EPA—600/8-88/048). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31316 **(PB—88-179874/XAB) Recommendations for and documentation of biological values for use in risk assessment.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Feb 1988. 351p. (EPA—600/6-87/008). NTIS, PC A16/MF A01.

The document was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response. The document consists of an extensive compliation of values gleaned from published literature sources for lifespan, body weight, food consumption, water consumption and inhalation volumes for a wide range of predominately mammalian species. Synthesis of the information to provide recommendations concerning parameters for conversion of exposure data (drinking water, food and air concentration) from mammalian toxicological studies to dose estimates in units of milligrams/kilogram body weight/day is provided.

31317 **(PB—88-179916/XAB) Health-effects assessment for isophorone.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 31p. (EPA—600/8-88/044). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31318 **(PB—88-179924/XAB) Health-effects assessment for methyl isobutyl ketone.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Apr 1987. 34p. (EPA—600/8-88/045). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31319 **(PB—88-179932/XAB) Health-effects assessment for chloromethane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Feb 1987. 40p. (EPA—600/8-88/024). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31320 **(PB—88-179940/XAB) Health-effects assessment for 1,2-dichloropropane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1987. 31p. (EPA—600/8-88/029). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31321 **(PB—88-179957/XAB) Health-effects assessment for dieldrin.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Aug 1987. 52p. (EPA—600/8-88/030). NTIS, PC A04/MF A01.

See also PB—86-134111.

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takes and carcinogenic potency presented in the document should be considered as preliminary and reflect limited resources allocated to the project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31322 **(PB—88-179965/XAB) Health-effects assessment for dimethylphenols.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 30p. (EPA—600/8-88/031). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31323 **(PB—88-180211/XAB) Health-effects assessment for 1,2-diphenylhydrazine.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 28p. (EPA—600/8-88/033). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31324 **(PB—88-180245/XAB) Health-effects assessment for ethylene dibromide.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Oct 1987. 54p. (EPA—600/8-88/037). NTIS, PC A04/MF A01.

See also PB—86-134111.

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31325 **(PB—88-180252/XAB) Health-effects assessment for ethylene glycol.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 44p. (EPA—600/8-88/038). NTIS, PC A03/MF A01.

See also PB—86-134111.

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31326 **(PB—88-180260/XAB) Health-effects assessment for ethyl ether.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 31p. (EPA—600/8-88/039). NTIS, PC A03/MF A01.

See also PB—86-134111.

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possible, two categories of values have been estimated for systematic toxicants (toxicants for which cancer is not the endpoint of concern). The first, RfDS or subchronic reference dose, is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs during a limited time interval. The RfD is an estimate of an exposure level that would not be expected to cause adverse effects when exposure occurs for a significant portion of the lifespan. For compounds for which there is sufficient evidence of carcinogenicity, q1*s have been computed, if appropriate, based on oral and inhalation data if available.

31327 **(PB—88-180443/XAB) Health and environmental-effects profile for nitroanilines.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Mar 1985. 49p. (EPA—600/X-85/115). NTIS, PC A03/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for nitroanilines was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for nitroanilines. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for nitroanilines is 100.

31328 **(PB—88-180468/XAB) Health and environmental-effects profile for malathion.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1984. 93p. (EPA—600/X-84/328). NTIS, PC A05/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for malathion was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Malathion has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for malathion is 0.02 mg/kg bw/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. Existing data are insufficient to determine an RQ value.

31329 **(PB—88-180476/XAB) Health and environmental-effects profile for methyl ethyl ketone.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 80p. (EPA—600/X-85/363). NTIS, PC A05/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for methyl ethyl ketone was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Methyl ethyl ketone has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for methyl ethyl ketone is 3.2 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for methyl ethyl ketone is 1000.

31330 **(PB—88-180500/XAB) Health and environmental-effects profile for nitrobenzene.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 82p. (EPA—600/X-85/365). NTIS, PC A05/MF A01.

See also PB—86-134111, and PB—88-178975.

The Health and Environmental Effects Profile for nitrobenzene was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Nitrobenzene has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for nitrobenzene is 0.032 mg/day for inhalation exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for nitrobenzene is 100.

31331 **(PB—88-180518/XAB) Health and environmental-effects profile for nitromethane.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Mar 1985. 47p. (EPA—600/X-85/116). NTIS, PC A03/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for nitromethane was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for nitromethane. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event

of a release as specified by CERCLA based on chronic toxicity. The RQ value for nitromethane is 1000.

31332 (PB—88-180534/XAB) Health and environmental-effects profile for methyl parathion. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1984. 89p. (EPA—600/X-84/329). NTIS, PC A05/MF A01.

See also PB—86-134111.

The Health and Environmental Effects Profile for methyl parathion was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Methyl parathion has been determined to be a systemic toxicant. An Acceptable Daily Intake (ADI), defined as the amount of a chemical to which humans can be exposed on a daily basis over an extended period of time (usually a lifetime) without suffering a deleterious effect, for methyl parathion is 0.28 mg/day for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. Existing data are insufficient to determine an RQ value.

31333 (PB—88-182175/XAB) Health and environmental-effects profile for styrene. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1984. 107p. (EPA—600/X-84/325). NTIS, PC A06/MF A01.

The Health and Environmental Effects Profile for styrene was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Styrene has been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for styrene is 2.47 (mg/kg/day)-2 for oral exposure. Quantitative estimates are presented provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for styrene. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. Existing data are insufficient to determine an RQ value.

31334 (PB—88-182217/XAB) Health and environmental-effects profile for propylene oxide. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1985. 89p. (EPA—600/X-85/401). NTIS, PC A05/MF A01.

The Health and Environmental Effects Profile for propylene oxide was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Propylene oxide has been evaluated as a carcinogen. The human carcinogen potency factor ($q1^*$) for propylene oxide is .239 (mg/kg/day)-2 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for propylene oxide is 1000.

31335 (PB—88-182688/XAB) Health and environmental effects profile for TCAB, TCAOB and TCHB. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jun 1985. 68p. (EPA—600/X-85/394). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for TCAB, TCAOB, and TCHB was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for TCAB, TCAOB, and TCHB. The Reportable Quantity (RQ) value of 1, 10, 100, 1000 or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ values for TCAB, TCAOB, and TCHB are 100, 100, and none, respectively.

31336 (PB—88-182696/XAB) Health and environmental-effects profile for vanadium pentoxide. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Apr 1985. 53p. (EPA—600/X-85/114). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for vanadium pentoxide was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous-waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for vanadium pentoxide. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for vanadium pentoxide is 100.

31337 (PB—88-182720/XAB) Health and environmental-effects profile for trimethyl phosphate. (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 66p. (EPA—600/X-85/367). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for trimethyl phosphate was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincin-

nati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates are presented, provided sufficient data are available. Trimethyl phosphate has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for trimethyl phosphate is .0383 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. The RQ value for trimethyl phosphate is 100.

31338 **(PB—88-182852/XAB) Health-effects assessment for ethyl chloride.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 25p. (EPA—600/8-88/036). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with ethyl chloride. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values are estimated for systemic toxicants.

31339 **(PB—88-182860/XAB) Health-effects assessment for fluorenes.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). May 1987. 28p. (EPA—600/8-88/040). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with fluorenes. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values have been estimated for systemic toxicants.

31340 **(PB—88-182878/XAB) Health effects assessment for parathion.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jul 1987. 44p. (EPA—600/8-88/047). NTIS, PC A03/MF A01.

See also PB—86-134111.

This report summarizes and evaluates information relevant to a preliminary interim assessment of adverse health effects associated with Parathion. All estimates of acceptable intakes and carcinogenic potency presented in this document should be considered as preliminary and reflect limited resources allocated to this project. The intent in these assessments is to suggest acceptable exposure levels whenever sufficient data are available. The interim values presented reflect the relative degree of hazard associated with exposure or risk to the chemical(s) addressed. Whenever possible, two categories of values are estimated for systemic toxicants.

31341 **(PB—88-183124/XAB) Health and environmental-effects profile for quinoline.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Sep 1985. 75p. (EPA—600/X-85/355). NTIS, PC A04/MF A01.

The Health and Environmental Effects Profile for quinoline was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste and Emergency Response to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA) and to provide health-related limits for emergency actions under Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates are presented, provided sufficient data are available. Quinoline has been evaluated as a carcinogen. The human carcinogen potency factor (q1*) for quinoline is 12.48 (mg/kg/day)-1 for oral exposure. The Reportable Quantity (RQ) value of 1, 10, 100, 1000, or 5000 pounds is used to determine the quantity of a hazardous substance for which notification is required in the event of a release as specified by CERCLA based on chronic toxicity. Existing data are insufficient to determine an RQ value.

31342 **Effects of deuteration on hematopoiesis in the mouse.** Adams, W.H.; Adams, D.G. (Brookhaven National Lab., Upton, NY (USA)). *Journal of Pharmacology and Experimental Therapeutics;* **244**: No. 2, 633-639(Feb 1988).

Mice ingesting 30 to 50% D_2O (heavy water, deuterium oxide) developed a dose-dependent depression of formed peripheral blood elements in 4 to 9 days. The principal mechanism of anemia and thrombocytopenia is impaired hematopoiesis. Despite pancytopenia in the peripheral blood, bone marrow cellularity and morphology remained normal. Upon replacement of D_2O with tap water, platelet and neutrophil concentrations returned to normal within 48 to 72 hr. In contrast, blood lymphocyte concentrations remained low for several weeks. B-lymphocytes may be more affected by deuteration than other lymphocyte subsets. In vivo reticuloendothelial cell function, as assessed by ^{51}Cr-labeled sheep erythrocyte clearance, was unaffected by D_2O. Although a dose-dependent decrease in fluid intake occurred during deuteration, hematocytopenia was not a consequence of dehydration. In view of the known kinetics of D_2O in biological systems, the rapid response of myeloid elements to deuteration must be due primarily to the solvent (nonmetabolic) isotope effect. Prolonged deuteration has proven toxic when included in regimens for treatment of neoplasia, including leukemia, in animal models. The present study shows that modulation of hematopoiesis by D_2O is possible without invoking the toxicities associated with prolonged deuteration.

31343 **Cannabinoids induce incomplete maturation of cultured human leukemia cells.** Murison, G.; Chubb, C.B.H.; Maeda, S.; Gemmell, M.A.; Huberman, E. (Argonne National Lab., IL (USA)). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 15, 5414-5418(Aug 1987). Contract W-31-109-ENG-38.

Monocyte maturation markers were induced in cultured human myeloblastic ML-2 leukemia cells after treatment for 1-6 days with 0.03-30 μM Δ^9-tetrahydrocannabinol (THC), the major psychoactive component of marijuana. After a 2-day or longer treatment, 2- to 5-fold increases were found in the percentages of cells exhibiting reactivity with either the murine OKM1 monoclonal antibody of the Leu-M5 monoclonal antibody, staining positively for nonspecific esterase activity, and displaying a promonocyte morphology. The increases in these differentiation markers after treatment with 0.03-1 μM THC were dose dependent. At this dose range, THC did not cause an inhibition of cell growth. The THC-induced cell maturation was also characterized by specific changes in the patterns of newly synthesized proteins. The THC-induced differentiation did not, however, result in cells with a highly developed mature monocyte phenotype. However, treatment of these incompletely matured cells with either phorbol 12-myristate 13-acetate of 1α,25-dihydroxycholecalciferol, which are inducers of differentiation in myeloid leukemia cells (including ML-2 cells), produced cells with a mature monocyte morphology. The ML-2 cell system described here may be a useful tool for deciphering critical biochemical events that lead to the cannabinoid-induced incomplete cell differentiation of ML-2 cells and other related cell types. Findings obtained from this system may have important im-

plications for studies of cannabinoid effects on normal human bone-marrow progenitor cells.

31344 Alkylation repair activity in the lung macrophages of smokers and nonsmokers. Cao, E.H.; Setlow, R.B.; Janoff, A. (Biology Dept., Brookhaven National Lab., Upton, NY 11973). pp 269 of Hematopoietic cellular proliferation: An international conference in honor of Eugene P. Cronkite. Bond, V.P.; Chandra, P.; Rai, K.R. New York, NY; The New York Academy of Sciences (1985). (CONF-8310231—).

From International conference on hematopoietic cellular proliferation; Upton, NY, USA (6 Oct 1983).

The alkylating agents that produce appreciable amounts of O^6-alkylguanine are strong carcinogens and the target tissues tend to be those in which the rate of repair of this product is very slow. The authors uses a simple assay to measure the ability of extracts of cells to repair O^6-methylguanine (m^6G). In this repair reaction, the methyl group is transferred stoichiometrically from DNA to an acceptor protein. The reaction is quantitated by incubating a cell extract with an exogenous DNA containing [methyl-^{3}H]m^6G and measuring the loss of radioactivity from the DNA or the gain in radioactivity by extract protein. The authors estimated the m^6G acceptor activity in macrophages obtained by lung lavage of 13 smokers and 8 nonsmokers. The acceptor activities in cell extracts of nonsmokers were, in femtomoles of methyl removed per 200 μg of protein, 50 to 100. These values are similar to those observed for extracts of peripheral blood lymphocytes. On the other hand, macrophage extracts gave values less than 10 in 11 of the smokers and 15 and 25 in the other 2. The low activity in smokers' macrophages is not the result of inhibition of methyl transferase by a component of the extract, since the extracts of smokers' cells do not inhibit the activity in extracts of nonsmokers' cells or of HeLa cells. Preliminary experiments indicate that the low activity in smokers' extracts arises from oxidation reactions in such cells, because treatment of them in vitro with the reducing agent dithiothreitol increases the activity by four- to fivefold to 50 to 80% of the activity of similarly treated cells from nonsmokers. The low acceptor activity in the lung macrophages of smokers implies that lung tissue exposed to smoke may also have low repair activity for m^6G. A low repair activity for m^6G would be expected to increase the carcinogenicity of simple nitrosamines in cigarette smoke.

5604 Other Environmental Pollutant Effects

31345 (AD-A—189087/0/XAB) Functional assessment of high-level laser irradiation. Annual progress report, 1 January-31 December 1985. Robbins, D.O. (Ohio Wesleyan Univ., Delaware (USA)). Nov 1985. 33p. NTIS, PC A03/MF A01.

Small foveal lesions produced by single, Q-switched (532 nm) pulses were difficult to detect both morphologically and behaviorally. These lesions were produced by pulses significantly above the ED 50 and their effects changed over time as perhaps edema and repair mechanisms proceeded. The initial deficits in visual functions were often slight and variable. As additional pulses were presented, the variability decreased while the visual deficit increased. Computer analyses of changes in grey scale taken from exposed retinae also change over time and correspond to the behavioral data.

31346 (AD-A—189133/2/XAB) Fundamental studies in the molecular basis of laser-induced retinal damage. Annual report, September 1983-September 1984. Lewis, A. (Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics). Sep 1984. 77p. NTIS, PC A05/MF A01.

Advances made in the work for the Ocular Hazards Program at the Letterman Army Institute of Research (LAIR) are described. The research has seen the first application of femtosecond lasers to the visual system; it is giving new insights into how these ultimate laser sources interact with biological tissue in general and with the visual system in particular. The authors have discovered that simple anions can activate visual photoreceptors in the dark; among these anionic activators is the dental agent fluoride. Research has continued into identifying selectively and spatially the image of various elements in photoreceptors and adjacent tissue. The authors were able to extend our preparation procedures to view the elemental composition of such components as melanin granules. The sensitive and selective spatial images should play important roles in extending understanding of the fundamental mechanisms of laser damage. The staining procedures developed can be applied to study laser-damaged retina. Data were obtained demonstrating rapid mechanical motions in vertebrate photoreceptors. Such rapid mechanical motions which parallel electrophysiological responses in the cell may lie at the very basis of photoreceptor function. Laser-damage mechanisms should now be reevaluated in terms of this new data. The effect of laser light on these newly discovered mechanical motions will surely lead to new and improved understanding of low-level laser ocular hazards.

31347 (AD-A—189154/8/XAB) Radiofrequency/microwave cell absorption and action spectroscopy. Annual report, 1 September-31 August 1986. Cleary, S.F.; Liu, L.M. (Medical Coll. of Virginia, Richmond (USA). Dept. of Physiology and Biophysics). 10 Nov 1987. 13p. NTIS, PC A03/MF A01.

Research during the contract year has included the following. An in-vitro tendon-explant model system was used to investigate the effects of weak ELF fields on fibroplasia and collagen synthesis. Maximum (33%) fibroplasia (relative to sham-exposed explants) was induced by 1-Hz square-wave pulsed fields at a time-averaged current density of 7mA/sq.m. Under these conditions, there were no effects on relative collagen synthesis. Lower or higher current densities had relatively less effects on fibroplasia. Maximal response occurred in explants oriented parallel rather than perpendicular to the E-field. At current densities of 14 mA/sq. m, fibroplasia, and collagen synthesis were suppressed but noncollagen protein synthesis was unaffected. A series of duplicate experiments was conducted to determine the effects of pulsed magnetic fields from Helmholtz coils on tendon-explant fibroplasia and collagen synthesis. No effects were detected on either dependent variable. In order to relate pulsed external applied fields to cellular alterations quasi-steady solution of Laplace's equation was obtained and programmed for computation. This solution will be used to calculate induced plasmalemma, nuclear and organelle membrane potentials and karyoplasmic and cytoplasmic potentials in response to pulsed DC electric fields and CW and pulsed RF fields.

31348 (AD-A—189337/9/XAB) Psychological effects of lasers on the battlefield: issues and ideas. Interim report, 1980-August 1987. Mastroianni, G.R.; Stuck, B.E. (Letterman Army Inst. of Research, San Francisco, CA (USA)). Sep 1987. 19p. (LAIR—246). NTIS, PC A03/MF A01.

Lasers are a new dimension in battlefield lethality. While we have a great deal to learn about the prevalence of laser injuries on the Airland Battlefield, it is probable that the injury rate will be substantial. Unlike physical effects, psychological effects of lasers result from exposure as well as the possibility of exposure (suppression). The rate of physical injury will be correlated with psychological exposure effects, but suppressive effects may be considerably more numerous. Advances in protection technology, for example, might reduce the expected impact of exposure effects but increase the suppressive effects of laser employment. Thus, consideration of psychological effects must proceed as an integral part of the overall laser bioeffects program.

31349 (AD-A—189855/0/XAB) Preliminary comparison of the transient effects of single versus multiple q-switched doubled-neodymium laser pulses. Final report, July-November 1986. Previc, F.H. (Krug International, San Antonio, TX (USA). Technology Services Div.). Sep 1987. 14p. NTIS, PC A03/MF A01.

A comparison between the effects of single and multiple laser pulse trains of equivalent energy was performed. Visual evoked potentials (VEPS) recorded bipolarly from the visual cortex of two rhesus monkeys in response to a counterphasing grating were used to assess the magnitude of the visual loss following four types of exposures: single and multiple pulses with total energies equal to 50% and 500% of the maximum permissible exposure (MPE) standard for humans. The results showed that the effects of a series of laser flashes presented within 200ms are similar to those

of a single laser flash whose energy is equivalent to the cumulative energy of the multiple-pulse exposure.

31350 **(PB—88-170923/XAB) Body temperature in the mouse, hamster, and rat exposed to radiofrequency radiation: an interspecies comparison.** Gordon, C.J.; Long, M.D.; Fehlner, K.S.; Stead, A.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 9p. (EPA—600/J-86/444). NTIS, PC A02/MF A01.

Pub. in Jnl. of Thermal Biology, Vol. 11, No. 1, 59-65(1986).

Colonic temperatures of BALB/c and CBA/J mice, golden hamsters, and Sprague-Dawley rats were taken immediately after exposure for 90 min to radiofrequency (RF) radiation. Exposures were made in 2450 MHz (mouse and hamster) or 600-MHz (rat) waveguide exposure systems while the dose rate, to specific adsorption rate (SAR), was continuously recorded. Experiments were performed on naive, unrestrained animals at ambient temperatures (Ta) of 20 and 30 C. Body mass and Ta were found to be significant factors in influencing the threshold SAR for the elevation of colonic temperature. The threshold SARs at Ta's of 20 and 30 C were, respectively: 27.5 and 12.1 W/kg for the BALB/c mouse; 40.7 and 8.5 W/kg for the CBA/J mouse; 8.7 and 0.61 W/kg for the golden hamster; and 1.58 and 0.4 W/kg for the Sprague-Dawley rat.

31351 **(PB—88-170949/XAB) Temperature regulation in the mouse and hamster exposed to microwaves in hot environments.** Gordon, C.J.; Long, M.D.; Fehlner, K.S.; Stead, A.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 9p. (EPA—600/J-86/446). NTIS, PC A02/MF A01.

Pub. in Health Physics, Vol. 50, No. 6, 781-787(1986).

Colonic temperature was measured in naive BALB/c mice and golden hamsters immediately following 90-min exposures to 2450-MHz radiofrequency (RF) radiation at an ambient temperature (Ta) of 32.2 or 35 C (dry air). Exposures were performed in a temperature-controlled waveguide that permitted continuous monitoring of the specific absorption rate (SAR) of RF energy. At a Ta of 32.2 C, the threshold SAR for elevating colonic temperature and the SAR resulting in a 1.0 C elevation in colonic temperature were, respectively, 4.3 and 10.0 W/kg for the mouse and 0.69 and 1.9 W/kg for the hamster. At a Ta of 35 C, these values were 0.12 and 5.3 W/kg for the mouse and 0.46 and 1.4 W/kg for the hamster. The SARs required to induce hyperthermia in the mouse and hamster at these relatively warm Ta's are considerably lower than those required at cooler Ta's of 20 to 3 C. Overall, the hamster became hyperthermic at lower SARs than in the mouse. Ta's of 35 C and greater are frequently encountered during heat waves in the summer months.

31352 **(PB—88-170956/XAB) Temperature regulation in the unrestrained rabbit during exposure to 600-MHz radiofrequency radiation.** Gordon, C.J.; Long, M.D.; Fehlner, K.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 13p. (EPA—600/J-86/447). NTIS, PC A03/MF A01.

Pub. in International Jnl. of Radiation Biology, Vol. 49, No. 6, 987-997(1986).

Six male New Zealand white rabbits were individually exposed to 600-MHz radiofrequency (RF) radiation for 90 min in a waveguide exposure system at an ambient temperature (Ta) of 20 or 30 C. Immediately after exposure, the rabbit was removed from the exposure chamber and its colonic and ear skin temperatures were quickly measured. The whole-body specific absorption rate (SAR) required to increase colonic and ear skin temperature was determined. At a Ta of 20 C, the threshold SAR for elevating colonic and ear skin temperature was 0.64 and 0.26 W/kg, respectively. At a Ta of 30 C, the threshold SARs were slightly less than at 20 C, with values of 0.26 W/kg for elevating colonic temperature and 0.19 W/kg for elevating ear skin temperature. The relationship between heat load and elevation in deep body temperature shown in the study at 600 MHz is similar to past studies that employed much-higher frequencies of RF radiation (2450-2884 MHz).

31353 **(PB—88-171020/XAB) Temperature-specific inhibition of human red cell (Na^+/K^+) ATPase by 2450-MHz microwave radiation.** Allis, J.W.; Sinha-Robinson, B.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 13p. (EPA—600/J-87/232). NTIS, PC A03/MF A01.

Pub. in Bioelectromagnetics 8, 203-212(1987).

The ATPase activity in human red blood cell membranes was investigated in vitro as a function of temperature and exposure to 2450-MHz (CW) microwave radiation. Assays were conducted spectrophotometrically during microwave exposure with a custom-made spectrophotometer-waveguide apparatus. Temperature profiles of total ATPase and Ca+2 ATPase (ouabain-inhibited) activity between 17 and 31 C were graphed as an Arrhenius plot. Each data set was fitted to two straight lines which intersected between 23 and 24 C. The difference between the total and Ca+2 ATPase activities, which represented the Na+/K+ ATPase activity, was also plotted and treated similarly to yield an intersection near 25 C. Exposure of membrane suspensions to a 6 W/kg dose rate at 1 C intervals between 23 and 27 C, resulted in an activity change only for the Na+/K+ ATPase at 25 C. The activity decreased by approximately 35% compared to sham-irradiated samples. An hypothesis based on the interaction of microwave radiation with enzyme structure during a conformational rearrangement is proposed as an explanation for the effect.

31354 **(PB—88-171129/XAB) Normalizing the thermal effects of radiofrequency radiation: body mass versus total body surface area.** Gordon, C.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 10p. (EPA—600/J-87/220). NTIS, PC A02/MF A01.

Pub. in Bioelectromagnetics 8, 111-118(1987).

The current guideline for exposure to radiofrequency radiation (RFR) of 0.4 W/kg may have inadvertently been set too high. The guideline is based on the rate of RFR absorption normalized with respect to body mass. Based primarily on data for work stoppage in the rat, the 0.4 W/kg guideline was calculated by the dividing the 4.0 W/kg dose by a safety factor of 10. However, if the RFR dose in the rat had been normalized with respect to surface area rather than body mass, the exposure guideline would be 2.3 W/sq m which translates, for a 80 kg adult, to an SAR of approximately 0.06 W/kg. Thus, the current RF exposure guideline may be several-fold greater than originally intended.

31355 **(PB—88-171137/XAB) Reduction in metabolic heat production during exposure to radiofrequency radiation in the rat.** Gordon, C.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 7p. (EPA—600/J-87/221). NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Physiology, Vol. 62, No. 5, 1814-1818(1987).

Male Sprague-Dawley rats were maintained at an ambient temperature (Ta) of 10 C and exposed to 600-MHz radiofrequency (RF) radiation while metabolic rate (MR) was measured by indirect calorimetry. RF radiation exposures were made in a waveguide-type system which permitted the continuous control of specific absorption rate (SAR). SAR's of 1 to 5 W/kg led to significant reductions in MR when averaged 30 to 60 min after the initiation of RF radiation exposure. The total decrease in MR during RF radiation exposure accounted for approximately 37% of the total RF heat load. Treatment of the rats to the same SARs at Ta of 10 C resulted in a significant elevation of colonic temperature. Thus, in spite of the decrease in MR, heat gain still exceeded heat loss during RF radiation exposure with a resultant elevation in deep body temperature.

31356 **(PB—88-171160/XAB) Comparative thermoregulatory response to passive heat loading by exposure to radiofrequency radiation.** Gordon, C.J.; Ali, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 8p. (EPA—600/J-87/265). NTIS, PC A02/MF A01.

Pub. in Comparative Biochemistry and Physiology, Vol. 88A, No. 1, 107-112(1987).

Colonic and tail-skin temperature of the unrestrained Fischer rat were measured immediately after a 90-min exposure to 600-MHz radiofrequency radiation in a waveguide-type system. Ambient temperature (Ta) was maintained at either 20, 28, or 35 C. The specific absorption rate (SAR) in dimensions of W/kg was controlled at a constant level through a feedback control circuit. The SAR needed to elevate colonic and tail-skin temperature decreased with increasing Ta. For example, a 0.5 C elevation in colonic temperature occurred at SAR's of 4.3, 0.9, and 0.5 W/kg when Ta was maintained at 20, 28, and 35 C, respectively. Data from this study were combined with data from earlier studies to assess the impact of varying Ta on the thermogenic effect of RF radiation in different species. In species ranging in mass from 0.02 to 3.2 kg, a double logarithmic plot of body mass versus SAR needed to elevate colonic temperature by 0.5 C was linear and inverse with a high goodness of fit ($r(2) = -0.94$). The highly correlated allometric relationship shows that, as body mass decreases, the relative impact of Ta on the thermogenic effect of RF radiation increases.

31357 **(PB—88-171418/XAB) Behavior, physiology, and energy deposition in rats chronically exposed to 2450-MHz radiation.** D'Andrea, J.A.; Gandhi, O.P. (Utah Univ., Salt Lake City (USA)). Nov 1987. 149p. NTIS, PC A07/MF A01.

The research program was initiated to determine both the specific absorption rate (SAR) and the behavioral and physiological consequences of chronic c-w microwave radiation exposure at 2450 MHz in the laboratory rat. Whole-body average and local SARs at discrete sites within the body of rats and mice were determined experimentally using different exposure systems and analytical techniques. The whole-body average SAR and the distribution of SAR within the body depends on a variety of factors: type of exposure system, polarization of the field, size of the animal, and angle of radiation incident on the body. Three experiments were conducted to determine the effects of chronic exposure to 2450-MHz microwave radiation on several measures of rat behavior and physiology. Groups of rats were exposed intermittently to 2450-MHz radiation at power densities of 0.5 mW/sq. cm. or 2.5 mW/sq. cm. for 90 days.

31358 **(PB—88-177068/XAB) Intermittent exposure of rats to 2450-MHz microwaves at 2.5 MW cm sq: behavioral and physiological effects.** D'Andrea, J.A.; DeWitt, J.R.; Emmerson, R.Y.; Bailey, C.; Stensaas, S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 16p. (EPA—600/J-86/454). NTIS, PC A03/MF A01.

Pub. in Bioelectromagnetics, No. 7, 315-328(1986).

Long-Evans male adult rats were intermittently exposed for 14 weeks to continuous wave (c-w) 2450-MHz microwaves at an average power density of 2.5 mW/sq. cm. The mean specific absorption rate was 0.70 W/kg (plus or minus 0.02 SEM). The rats were exposed 7 h/day, 7 days/week in a radiation chamber with a monopole above ground, while housed in Plexiglas cages. Weekly measures of body mass and food intake did not indicate statistically significant effects of microwave irradiation. Assessments of threshold for electric-footshock detection revealed a significant difference between microwave and sham-exposed animals. Assessments of cholinesterase and sulfhydryl groups in blood and 17-ketosteriods, in urine did not distinguish the two groups of rats. Behavioral measures made at the end of the 14-week exposure included an open-field test, shuttlebox avoidance performance, and schedule-controlled lever-pressing for food pellets: Statistically significant differences between microwave- and sham-exposed rats were observed for these measures. Examination of adrenal tissue, plasma electrolytes, and organ masses after 14 weeks of exposure revealed no difference between the two group of rats.

31359 **(PB—88-177076/XAB) Behavioral and physiological effects of chronic 2450-MHz microwave irradiation of the rat at 0.5 MW/cm sq.** D'Andrea, J.A.; DeWitt, J.R.; Gandhi, O.P.; Stensaas, S.; Lords, J.L. (Utah Univ., Salt Lake City (USA)). 1986. 14p. NTIS, PC A03/MF A01.

Pub. in Bioelectromagnetics, Vol. 7, 45-56(1986).

Adult male Long-Evans rats were intermittently exposed to 2450-MHz c-w microwaves at an average power density of 0.5 mW/sq. cm. for 90 days. The resulting SAR was 0.14 W/kg (range 0.11 to 0.18 W/kg). The animals were exposed 7 h/day, 7 days/wk, for a total of 630 h in a monopole-above-ground radiation chamber while housed in Plexiglas holding cages. Daily measures of body mass and food and water intake indicated no statistically significant effects of microwave exposure. Monthly assessment of reactivity to electric footshock, levels of cholinesterase and sulfhydryl groups in blood, and 17-ketosteroids in urine revealed no reliable differences between 14 sham- exposed and 14 microwave-exposed rats. After the 90 days of exposure, seven rats, randomly chosen from each group, were assessed for open-field behavior, shuttlebox performance, and schedule-controlled (IRT schedule) lever pressing for food pellets. Statistically significant differences between microwave-exposed and sham-exposed rats were observed in shuttlebox performances and lever pressing. Post mortem measures of mass of several organs and microscopic examination of adrenal tissue revealed no differences between the two groups of animals.

31360 **(PB—88-179189/XAB) California vehicle noise-emission levels. Final report, 1982-1987.** Hendriks, R.W. (California State Dept. of Transportation, Sacramento (USA). Transportation Lab.). Jan 1987. 281p. (TL—604214). NTIS, PC A13/MF A01.

See also PB—85-221042.

The California Department of Transportation (Caltrans) is required by standards to predict noise levels for proposed federal-aid highway projects. For these predictions Caltrans uses national vehicle-noise reference emission levels, which are based on 1975 data collected in North Carolina, Florida, Washington, and Colorado. In 1982, Caltrans initiated a study in response to the need for California data. The report presents criteria, methods, and analyses used to develop California vehicle noise-emission levels for level roads and heavy-truck emission levels on grades. More than 3000 noise and environmental measurements were made at sixteen level-road sites in California. Included were automobiles and medium and heavy trucks traveling at constant speeds between 25 and 65 mph. Microphones were located at distances of 25, 50, and 100 feet, and at heights of 5 and 10 feet. Nearly 1800 measurements were made of heavy truck noise at constant uphill speeds from 10 to 65 mph at six road sites ranging in grade from +3% to +7%.

31361 **(PB—88-192711/XAB) Guide for establishing and maintaining a calibration-constancy intercomparison system for microwave-oven-compliance survey instruments (revised).** (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). Mar 1988. 25p. (HHS/PUB/FDA—88-8264). NTIS, PC A03/MF A01.

See also PB—87-107900.

Public Law 90-602, the Radiation Control for Health and Safety Act of 1968 (the Act), directs the Department of Health and Human Services to evaluate production-testing and quality-control programs carried out by the industry to assure adequacy of safeguards against hazardous electronic-product radiation and to assure that the products comply with performance standards. Under the Act, manufacturers of microwave ovens, a product listed under 21 CFR 1002.61, are required to certify that their microwave ovens are in compliance with all of the applicable provisions of the Federal Performance Standard for Microwave Ovens, 21 CFR 1030.10. In order to comply with microwave-emission-level provisions of the performance standard, manufacturers must use properly calibrated microwave-leakage measurement instruments in their production and quality control testing programs. This document was prepared in order to assist the microwave oven manufacturers in establishing and maintaining a calibration-constancy intercomparison system for compliance survey instruments and replaces guidance previously issued by the Center for Devices and Radiological Health (the Center).

31362 **(PB—88-861596/XAB) Laser radiation: health hazards and adverse biological effects. June 1975-March 1988 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for June 1975-March 1988.** (National Technical Information Service, Springfield, VA (USA)). Mar 1988. 79p. NTIS PC N01/MF N01.

Supersedes PB—87-855722.

This bibliography contains citations concerning human-injury thresholds, protective devices, and safety practices involving laser radiation in industrial and military applications. Excluded are references to lasers in surgery or medicine, which are found in other published searches. (This updated bibliography contains 165 citations, 16 of which are new entries to the previous edition.)

31363 **Recent studies in the behavioral toxicology of ELF electric and magnetic fields.** Lovely, R.H. (Battelle, Pacific Northwest Laboratories, Richland, WA (USA)). *Progress in Clinical and Biological Research;* **257**: 327-347(1988).

Behavioral responses to ELF electric and magnetic fields are reviewed starting with the simple sensory awareness or detection by an animal and moving on through more-complicated behavioral responses such as behavior that averts exposure. The literature selected in this review is taken primarily from the area of behavioral toxicology. As such, it does not review work on specialized response systems to ELF fields. The most notable of these omitted specialized response systems are electroreception, which occurs in a number of fish species, and homing/navigation and communication of the location of food that occurs in several species of birds and in honeybees, respectively. The toxicologic orientation of most researches that evaluate the effects of exposure to ELF electric and magnetic fields has been influenced primarily by the missions of DOE and the power industry programs to determine the health effects of power frequency (50- and 60-Hz) electric and magnetic fields. Because of these large programmatic efforts, most of the recent research has in fact been done at 50 or 60 Hz. In the context of the above limitations, remarkably few robust behavioral effects have been reported. Those that have been reported probably relate to an animal's perception of the electric field, although there are some exceptions to this generalization. The apparent lack of deleterious effects in animals is consistent with recent studies on humans that have been conducted in the UK. With this in mind, it is tempting to conclude that exposure to an ELF field is a rather innocuous event and, other than possible mini-shocks, is without hazard. 43 references.

31364 **Microwave attenuation of ethanol-induced hypothermia: ethanol tolerance, time course, exposure duration, and dose response studies.** Hjeresen, D.L.; Francendese, A.; O'Donnell, J.M. (Los Alamos National Lab., NM (USA)). *Bioelectromagnetics (New York);* **9**: No. 1, 63-78(1988).

Four experiments were conducted to quantify the reported attenuation by microwave (MW) irradiation of ethanol-induced hypothermia. In one experiment rats were irradiated (continuous wave 2.45 GHz, specific absorption rate = 0.3 W/kg) or sham irradiated for 45 min, injected with 3.6 g/kg, 20% (v/v) ethanol (EtOH) or saline (NaCl) i.p.. Colonic temperature was monitored at 20-min intervals for 2 h. This procedure was repeated for 8 days to determine the rate of tolerance development to the hypothermic effect of ethanol. While MW irradiation did significantly attenuate EtOH-induced hypothermia, it did not enhance or retard the rate of tolerance development. To determine the duration of irradiation necessary to attenuate EtOH-induced hypothermia, groups of rats were irradiated or sham irradiated for 5, 15, 30, or 60 min prior to EtOH injection and subsequent temperature measurements. The attenuation was apparent only after 60 min of irradiation. To determine the duration of the attenuation effect after irradiation, rats were injected with EtOH or NaCl at 0, 30, 60, 120, or 480 min after 45 min of irradiation or sham irradiation. The attenuation effect was apparent among rats injected 0 to 30 min after irradiation and for the first 40 min for groups injected at 120 min. Additional rats were injected with NaCl or 0.9, 1.8, or 2.7 g/kg of EtOH i.p. following 45 min of irradiation or sham irradiation to determine if the attenuation effect depends on the dose of EtOH administered. Attenuation of EtOH-induced hypothermia was more apparent at lower doses of EtOH than at higher doses. These results indicate that the effect is an acute response to irradiation, and rule out several other potential explanations.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 30116

31365 **(CONF-880583—1) Analysis of hydraulic conductivities in fractured rocks near Oak Ridge, Tennessee.** Moore, G.K. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 14p.

From International confernce of fluid flow in fractured rocks; Atlanta, GA, USA (15 May 1988).

More than 1,500 observation wells have been drilled near Oak Ridge National Laboratory since 1949, and more than 380 values of hydraulic conductivity have been determined. Groundwater in this area occurs in fractures in the regolith and the underlying bedrock. The hydraulic conductivity data show that water-bearing fractures are very common but that most wells yield less than 1 L/min of water. These data are lognormally distributed, and there are only local similarities in the hydraulic conductivities of nearby wells. Analysis of the data using cumulative probability graphs shows several significant deviations that otherwisse would have been obscure. There is almost no difference between the hydraulic conductivities of regolith wells and bedrock wells, suggesting a similar mode of groundwater occurrence in these materials. There is also little difference between wells in the Conasauga Group and wells in the Chickamauga Group, suggesting that lithologic differences are less important than other factors in determining the spatial frequency and aperture of open fractures in these units. Comparison of hydraulic conductivity values grouped by well depth and by the depth of packer tests in coreholes shows two distinctive populations. The characteristics of the first population can be used to predict groundwater flows and well yields to a depth of about 20 m. The characteristics of the second population can be used to predict flows and yields at deeper levels. 15 refs., 2 figs., 4 tabs.

31366 **(DOE/ER/13722—1) Energy related studies utilizing microcline thermochronology: Progress report, May 1, 1987-April 30, 1988.** (State Univ. of New York, Albany (USA)). 1988. Contract FG02-87ER13722. 5p.

Rock samples from the Salton Sea Geothermal Field (sandstone, tuff, granite) and from accretionary prism sediments along the convergent margins in southeast Alaska and southwest Japan have been dated by the $^{40}Ar^{39}Ar$ method. Paleotemperatures have been calculated. (ACR)

31367 **(NUREG/CR—5097) Simulation of liquid and vapor movement in unsaturated fractured rock at the Apache Leap Tuff Site: Models and strategies.** Yeh, T.C.; Rasmussen, T.C.; Evans, D.D. (Arizona Univ., Tucson (USA). Dept. of Hydrology and Water Resources). Mar 1988. 73p.

The physical, hydraulic and pneumatic properties of variably saturated, fractuerd tuff are currently being evaluated at the Apache Leap Tuff Site, located near Superior, Arizona. Nine inclined boreholes, the deepest of which penetrate to a depth of thirty meters, have yielded over 270 m of oriented core. Field and laboratory data with regard to matrix and fracture properties are being collected which will be used to characterize the site. A description of the characterization parameters as well as field and laboratory techniques used to collect the parameters is presented. To extend the characterization to larger scales, as well as to interpret collected data, computer simulation modeling will be performed. A review and description of available computer models is presented. Recommendations for site characterization includes the use of analytic stochastic models, equivalent porous media models, and discrete fracture network models. Such models may accurately reproduce the expected dual porosity, three-dimensional characteristics of fluid flow at the Apache Leap Tuff Site. Also, the variable saturation which exists within fractures and the matrix at the site will also be reproduced. Simulation scenarios including constant head and flux surface boundary conditions, as well as slug and cyclic surface boundary conditions are recommended. 240 refs., 11 figs.

31368 **Regional underpressuring in deep brine aquifers, Palo Duro Basin, Texas 2. The effect of Cenozoic Basin Development.** Senger, R.K.; Kreitler, C.W.; Fogg, G.E. (Univ. of Texas, Austin (USA)). *Water Resources Research;* 23: No. 8, 1494-1504(Aug 1987).

The evolution of sedimentary basins, involving uplift, deposition, and erosion causes major changes in basin hydrodynamics and the hydrochemistry of basinal fluids. The role of these geologic processes is examined in the Palo Duro Basin of Texas with the help of a cross-sectional ground water flow model employing time-dependent boundary conditions and a source term representing erosional unloading. Transient simulations of ground water flow show that uplift and tilting of the basin (10-15 m.y. ago) caused a significant increase in ground water flow rates. Timing of the erosional events implies that significant underpressuring (head difference between shallow and deep aquifers in excess of 175 m) and change in the ground water flow pattern occurred within the last 1-2 m.y. as a results of erosional retreat of the Eastern Caprock Escarpment. Modeling also indicates that erosional unloading associated with the retreat of the Caprock Escarpment was ineffective in creating large-scale underpressuring in the Deep-Basin Brine aquifer. Only in the vicinity of the escarpment could erosional unloading and the resulting expansion of the underlying aquitard create significant subhydrostatic conditions within the aquitard.

5802 Geophysics

REFER ALSO TO CITATION(S) 30114, 30908, 31012, 31094

31369 **(CEA-DAS—406) Studies of historical seismicity in France.** Levret, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Nov 1987. 16p. (In French). (CONF-8704286—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753053/JAW.

From AIEA working group on historical seismicity in mediterranean basin; Madrid, Spain (1 Apr 1987).

Since 1975 in order to be in conformity with the requirements of the French nuclear program, a review of historical seismicity was undertaken in France. The method adopted for reviewing historical earthquakes who entails a systematic consultation of the original sources and their critical analysis in order to obtain a new interpretation, led to compile a computer file covering a period of time of about a millenary. The abundant contributions result of continuous researches involve annualy up-date of the file where macroseismic data each one assigned with a degree of reliability are recorded.

31370 **(EPRI-NP—5747) Soil response to earthquake ground motion: Final report.** Silva, W. (Woodward-Clyde Consultants, Walnut Creek, CA (USA)). Mar 1988. 292p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920246/JAW.

The validity of two fundamental assumptions in the analysis of dynamic site response to earthquake ground motion is examined: (1) The adequacy of modeling at a site by vertically propagation shear waves was evaluated using data recorded by vertical arrays. Results suggest that about 75% of the power observed at the surface of a soft site can be modeled as vertically propagating shear waves, and only in a limited bandwidth from several seconds to 15 Hz. The remaining 25% of the total surface power may arise from scattered or laterally propagating seismic energy. The implications of this on deconvolution of ground motion to depth is discussed. (2) The strain dependence of in-situ material properties was examined using strong and weak ground motion recorded at soil sites and at nearby rock sites. Response and Fourier spectra obtained from site response analyses using linear, equivalent-linear, and nonlinear (STEALTH) techniques were compared to each other and to observed data. The results suggest nonlinear soil response occurred only for surface motion in excess of 30% g. The transition region from linear to nonlinear response may be abrupt and occurred at strain levels around 10^{-2}%. 114 refs., 93 figs., 6 tabs.

31371 **(LA—11072-MS) Seismic hazards investigations at Los Alamos National Laboratory, 1984 to 1985.** Gardner, J.N.; House, L. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 128p. NTIS, PC A07; GPO Dep. Order Number DE88007166/JAW.

The Pajarito fault system, part of which skirts the western boundary of Los Alamos National Laboratory, is a major, active structural element of the Rio Grande rift. We have mapped over 100 km of interrelated fault zones and traces that constitute the fault systmem in the vicinity of Los Alamos. The style of deformation in the fault system gradually transforms from normal slip, to normal oblique slip, to dominantly right lateral strike-slip motions from south to north. Most significant movements (>100 m) on the fault system in the vicinity of Los Alamos have occurred within the last 1.1 million years. Portions of the fault system may have associated microseismic activity. Available evidence indicates tha major movements have occurred on the fault system in the last 500,000 years and as recently as 350,000 years ago, 240,000 years ago, 42,000 years ago, possibly <10,000 years ago, and 2000 years ago. Some limited, inferential field data imply the fault system generates characteristic earthquakes in the magnitude (Richter) range 6.5 to 7.8. Extrapolation of frequency-magnitude relations, derived from the 10 years of data from the Los Alamos seismograph net, to estimate large expectable earthquakes is unrealistic, and based on the findings of other workers the result is most likely a substantial underestimate. 77 refs., 11 figs., 4 tabs.

31372 **(LBL—24735) Seismic body waves and the earth's inner core.** Cummins, P. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 138p.

In this study short-period body wave sismograms are numerically modeled to investigate the sensivity of core phase waveforms to structure near the Earth's inner core boundary (ICB). A calculation technique is developed which is a hybrid combination of asymptotic and discrete-layer reflectivity methods, the former being applicable to the smoothly-varying layers of the mantle and outer core, whereas the latter is used for the more complicated structure near the ICB. This technique facilitates the consideration of a large number of different models for structure near the ICB. 42 refs., 10 figs., 1 tab.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 30385, 30804, 31367

31373 **(LA—11169-T) The effect of micro-structure on the macroscopic behavior of cemented granular material.** Trent, B.C. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 260p.

In order to improve the physical understanding of the phenomenology associated with the deformation of highly porous geologic materials such as alluvium, the details of inter-granular rolling, shearing and extension have been studied for cemented particles. Two-dimensional analytic expressions are derived that relate the response of two bonded particles to deformations of an elastic adhesive material. A two-dimensional version of the distinct element code, TRUBAL, was modified by incorporating these analytic relations into the calculational sequence. A modified Griffith criterion isused to trigger inter-particle fracture in quasi-static and dynamic regimes. The details of the implementation of these features into TRUBAl are decribed and the necessary modifiations to the stress tensor calculation are developed. The evolution of multiple particle clusters is investigated in several quasi-static and dynamic numerical experiments. The calculational results are compared to laboratory data and macroscopic constitutive laws. Scanning electron micrographs and thin section photomicrographs are provided, illustrating some strengths and limitations of the model. 50 refs., 153 figs., 8 tabs.

31374 **(LA-UR—87-4218) Microstructural effects in static and dynamic numerical experiments.** Trent, B.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880654—3).

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

A numerical analysis of cemented granular material has been performed in order to better understand the relationship between the individual components of a rock matrix and the macroscopic constitutive response. A distinct element code was modified to allow interparticle bonding by incorporating appropriate elastic relationships. A modified Griffith criterion was utilized to initiate fracture within individual bonds. A number of quasi-static and dynamic numerical experiments are presented which show that realistic macroscopic behavior may be obtained without the use of phenomenological formulations such as plasticity. 9 refs., 17 figs.

31375 **(SAND—87-3018C) The effects of normal stress history on rock friction.** Olsson, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 7p. (CONF-880654—2). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88004022/JAW.

From 29. U.S. symposium on rock mechanics; Minneapolis, MN, USA (13 Jun 1988).

Two types of tests were run to investigate the response of the shear stress to changes in the normal stress during stationary contact with rock. It was found that the history of the normal stress across smooth surfaces of rock has a measurable influence on the friction stress. 15 refs., 6 figs., 1 tab.

5805 Oceanography

31376 **(DOE/ER/60337—1) Role of bacteria in organic matter fluxes in the southern California coastal zone: Progress report, May 1985-May 1986.** Azam, F. (California Univ., San Diego, La Jolla (USA). Inst. of Marine Resources). Jun 1986. Contract FG05-85ER60337. 11p. (UCSD—86-1481).

During the 1985-1986 funding period, our laboratory participated in two cruises (October 1985; May 1986) to the study area in Santa Monica Basin. The purpose of measuring bacterial secondary production (BSP) was to determine the importance of heterotrophic bacterioplankton as a route for carbon flux in the study area BSP was measured by the tritiated thymidine method. It is of interest to determine the factors which influence BSP in the euphotic zone. Our data on BSP and bacterial enumeration showed that within the euphotic zone the bacterial (average) generation time range was 25.8-52.4 h. Below the euphotic zone bacterial growth was much slower. We employed ^{3}H-glutamic acid as a tracer to study spatial trends in microbial utilization of dissolved free amino acids (DFAA), particularly onshore-offshore differences and the presence and persistence of the benthic boundary layer feature. Our research was designed to address the assumptions that a single constituent of a specific dissolved organic carbon pool (in our case, glutamic acid and dissolved free amino acids, respectively) can be effectively employed to follow the utilization and turnover of the pool, and incorporation and respiration of identical substrates labelled with ^{3}H or ^{14}C is indistinguishable. We will isolate and characterize the dominant microorganism in the surface microbial biomass is dominated by a large (3-5 μm diameter) filamentous organism of unknown identity. 4 figs.

31377 **(DOE/ER/60337—2) Role of bacteria in organic matter fluxes in the southern California coastal zone: Progress report, May 1986-May 1987.** Azam, F. (California Univ., San Diego, La Jolla (USA). Inst. of Marine Resources). Jun 1987. Contract FG05-85ER60337. 8p. (UCSD—87-1478). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88007061/JAW.

Our objective was to determine the quantitative significance of heterotrophic bacteria in the fate of biogenic production in the epipelagic, mesopelagic and the benthic boundary layer of the water column in the study area. We employed bacterical production rates, as the basis for calculating organic matter flux into bacteria. We have been studying the mechanisms by which organic matter flux into bacteria takes place. We have initially chosen to focus on dissolved protein pool. Measurements done under this program show that much of the bacterially-utilizable organic nitrogen pool in the study area occurs in the form of dissolved proteins/peptides (dissolved combined amino acids, DCAA). Microheterotrophic utilization (cell incorporationplus respiration) of DFAA was examined in the May and October 1986 cruises in depth profiles in the Santa Monica Basin. Utilization rates were most rapid in the euphotic zone, decreased considerably at mid-depths, and increased again in the deepest basin waters. Findings indicate that these are unique bacteria capable of growing in extremely dilute concentrations of substrates, e.g., typical of those found in natural seawater. They have been isolated from many Pacific Ocean locations and depths. These low-nutrient bacteria were used to assay seawaters for avialble dissolved organic matter. 7 refs.

31378 **(DOE/ER/60338—3) Program of mineralization and cycling in marine systems: Organic geochemistry of particulate and sediments (CaBS): Progress report ending May 1987 of the project.** Venkatesan, M.I.; Kaplan, I.R. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Jun 1987. Contract FG05-85ER60338. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007130/JAW.

The objective of this study is to generate a dynamic model of the processes involved in the cycling of organic carbon in the sediments and the wates of the southern California Bight by the chemical and biological characterization of sedimenting particles interceptd in the water column at various depths as well as from recent sediments. At UCLA, the quantitative data of the various organic compounds in the sediments (cores) and particles from the interceptor traps deployed from the water column are gathered to determine the processes occurring in the water column and sedimentary regimes.

31379 **(DOE/ER/60341—2) A proposal to measure the density and nutrient fields at openings to a marine basin and to model the fluxes within the basin: Progress report, 1 June 1986-31 May 1987.** Jackson, G.A. (Scripps Institution of Oceanography, La Jolla, CA (USA)). Jun 1987. Contract FG05-85ER60341. 4p. (UCSD—87-1479). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88007062/JAW.

This project is part of the multi-investigator, multi-disciplinary West Coast program to study the carbon flux in marine basins (California Basin Study-CaBs). My role, and that of my group, in this program is to integrate various results using computer models. For a variety of reasons, my role has also evolved to include measuring the distributions of dissolved oxygen, nutrients, total organic nitrogen (TON), and total organic carbon (TOC), coordinating the ship scheduling and coordinating sampling with the California Cooperative Fisheries Investigation (CalCOFI) program. My collaborators and I continue to collect water samples during the CaBS cruises and analyze them for nutrient and dissolved concentrations. There have been two of these in the last year. The CalCOFI program has increased the spatial coverage of its quarterly oceanographic survey off California. The extra sampling decreases the station spacing on their line across the Santa Monica Bay/Basin and increases the maximum sampling depth at which they measure temperature, salinity, oxygen, and nutrients from 500 m to near the basin bottom at 900 m. Thus far, I have received from two cruises last year. This cooperation increases the temporal resolution of our observations. Results are being incorporated into our data set for the area.

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 30971, 30978, 30982, 31628, 31815

31380 **(AD-A—189132/4/XAB) Hf (high-frequency) maximum usable frequency (MUF) model uncertainty assessment. Research report.** Roy, T.N.; Sailors, D.B. (Naval Ocean Systems Center, San Diego, CA (USA)). Jun 1987. 116p. (NOSC/TR—1184). NTIS, PC A06/MF A01.

A statistical analysis of observed oblique sounder median maximum observed frequencies (MOF) and predicted maximum usable frequencies (MUF) was used to assess the accuracy of high-frequency MUF prediction. A data base of 13,054 hours of oblique

sounder MOFs measured on 70 paths was compared with the predicted MUF values from MINIMUF-3.5, MINIMUF 85, and an unrelated MUF model, the HF Broadcast WARC model (HFBC84). The data were screened into subsets to determine the effect of particular paths, path length and orientation, season, month, latitude, sunspot number, diurnal trends, geographic region, and sounder type. The accuracy of all three models was very close, with the MINIMUF-3.5 model having the lowest RMS error of 4.44 MHz. MINIMUF 85 was next, with an RMS error of 4.58 MHz, and HFBC84 was last, with an error of 4.67 MHz, and MINIMUF 85 last, with 1.28 MHZ. Correlation was good for all three models. Correlation coefficients were .824, .819, and .827 for MINIMUF-3.5, MINIMUF 85, and HFBC84, respectively. Future improvements to the MINIMUF model are discussed- and current MUF computer algorithms are included in the appendices.

31381 **(AD-A—189181/1/XAB) Coronal mass ejections.** Kahler, S. (Emmanuel Coll., Boston, MA (USA). Physics Research Div.). Apr 1987. 13p. NTIS, PC A03/MF A01.

Pub. in Reviews of Geophysics, Vol. 25, No. 3, 663-675(Apr 1987).

U.S. research in coronal mass ejection (CMEs) over the 1983-1986 quadrennium is reviewed. Nearly all observational results derive from the white-light coronagraphs on the P-78 and SMM spacecraft. Statistical compilations of occurrence rates, angular widths, latitudes, and speeds of CMEs are discussed. Other broad topics are: the associations of CMEs with coronal and interplanetary shocks; the theory of CME origin; the structures of CMEs; and the interplanetary signatures of CMEs.

31382 **(AD-A—189301/5/XAB) VLA (Very Large Array) observations of a solar-noise storm.** Lang, K.R.; Willson, R.F. (Tufts Univ., Medford, MA (USA)). 1 Aug 1987. 10p. NTIS, PC A02/MF A01.

Pub. in The Astrophysical Journal, Vol. 319, No. 1, Pt. 1, 514-519(1 Aug 1987).

The first Very Large Array (VLA) observations of the Sun at 92-cm wavelength (328 MHz) are presented. A solar-noise storm, which lasted at least 3 hr, was detected at this wavelength; it consisted of burstlike spikes superposed on a slowly varying background, and both components were 95% + or - 5% right-hand circularly polarized. A long-duration soft x-ray event preceded the radio radiation by 30 minutes, suggesting a disturbance moving outward at a velocity of v=78 km/s. The 92-cm noise storm was resolved with an angular resolution 9 arc sec for time intervals as short as 13 s. Snapshot maps revealed a persistent elongated source at successive peaks, with a scatter in the source position. A systematic position shift of Delta Theta > or = 15 can be produced by the Earth's ionosphere, but these effects can be removed by frequent observations of a nearby calibrator source. Previously reported trends are confirmed for a decrease in source size at higher frequencies. The new VLA results are also consistent with previous observations of noise-storm polarization and height. The VLA can potentially resolve both the burst and continuum components of noise storms, while also detecting the effects of anisotropic scattering in the corona. The high angular resolution and large collecting area of the VLA may lead to the detection of the second harmonic of the storm plasma frequency or establish important limits to it.

31383 **(AD-A—189327/0/XAB) Development of high-stability fiber-optic spectrophotometric systems for study of solar/stellar magnetic activity. Final report, 15 June 1983-15 June 1986.** Ramsey, L.W. (Pennsylvania State Univ., University Park (USA). Dept. of Astronomy). 17 Feb 1987. 25p. NTIS, PC A03/MF A01.

This observational program is for studing magnetic-activity cycles in solar-type stars, including the Sun. The goal proposed is to establish the relationships between a star's magnetic-cycle morphology (i.e., amplitude, period, shape, regularity, etc.) and its age, rotation rate, and if possible, differential rotation rate, for a variety of solar-like stars. Basic empirical input will be provided into the construction of a viable dynamical dynamo theory for the Sun and the stars, leading to a deeper understanding of the ultimate origins of solar and stellar magnetism. Only when a realistic theory of magnetic-field generation is available can one understand fully the physics of magnetic activity, which manifests itself on all temporal and spatial scales, from transients such as flares to long-lived structures such as quiescent prominences, from flux-tubes at the limit of resolution to complex groups of sunspots. A critical first step in this effort was the development of an appropriate instrument. An advanced-design, special-purpose, fiber-fed spectrograph, carefully optimized to make the required observations with maximum efficiency is described. This contract designed and fabricated a breadboards instrument, and tested it both in the laboratory and with telescopic observations. The results of those tests and ancillary tests of the properties of optical fibers are discussed.

31384 **(AD-A—189688/5/XAB) MAXIE 1: program report for 1 October-31 December 1987. Progress report.** Imhof, W.L.; Voss, H.D.; Chinn, V. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 17 Dec 1987. 6p. (LMSC/D—068466). NTIS, PC A02/MF A01.

The satellite flight of the MAXIE-1 (Magnetospheric Atmospheric X-ray Imaging Experiment) instrument is being implemented under ONR (the Office of Naval Research) sponsorship. The MAXIE-1 instrument is being developed as a joint activity of Lockheed, the Aerospace Corporation, and the University of Bergen; much of the Lockheed development has been done under the Independent Research Program. Under ONR sponsorship that institution is responsible for managing the program, for providing spacecraft interface requirements, for providing interface activities undertaken in the last three months. Interactions have continued with co-investigators at the Aerospace Corp. and at the University of Bergen. NASTRAN model calculations, thermal analyses and an updated MAXIE assembly drawing and other drawings have been provided to RCA.

31385 **(IC—87/202) Radiation transfer through coagulating media.** Elwakil, S.A.; Saad, E.A.; Abdelkrim, M.S.; Attia, M.T. (International Centre for Theoretical Physics, Trieste (Italy); Mansoura Univ. (Egypt). Physics Dept.). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702651/JAW.

Exact relations for radiation heat flux at the boundaries of a slab with reflecting boundary conditions and internal sources are obtained in terms of the albedos of a source free slab with isotropic boundary conditions. Available exact values of the albedos give exact values of radiation heat flux. Configuration factors are calculated for comparison. (author). 10 refs, 1 tab.

31386 **(IC—87/286) Gravitational redshift of self-gravitating systems of dark matter in the universe.** Zhang Yuanzhong; Jin Kejian. (International Centre for Theoretical Physics, Trieste (Italy); North Jiaotuong Univ., Beijing, BJ (China). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702688/JAW.

We assume that two kinds of fermions with different masses are included in dark matter of the Universe. These fermions may form stable self-gravitating systems. Gravitational redshifts in the centre of the systems were calculated and a maximum value (1.22) of the redshift was found. (author). 4 refs, 2 figs.

31387 **(IC—87/334) Global solar radiation in Sierra Leone (West Africa).** Massaquoi, J.G.M. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702725/JAW.

A correlation equation of the Angstrom type has been developed to predict the monthly average daily global solar irradiation incident on a horizontal surface in Freetown, Sierra Leone. Measurements of the global insolation have been compared with those predicted using the equation. A good agreement (greater than 95% in most cases) was observed between the measured values and the predicted ones. (author). 15 refs, 2 tabs.

31388 (N—88-19400) **Modeling analysis program for the JPL table mountain Io sodium cloud data. Final report, 1 June 1984-30 November 1987.** Smyth, W.H.; Goldberg, B.A. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). Mar 1988. 337p. (NASA-CR—182555; NAS—1.26:182555). NTIS, PC A15/MF A01.

Research in the third and final year of this project is divided into three main areas: (1) completion of data processing and calibration for 34 of the 1981 Region B/C images, selected from the massive JPL sodium cloud data set; (2) identification and examination of the basic features and observed changes in the morphological characteristics of the sodium cloud images; and (3) successful physical interpretation of these basic features and observed changes using the highly developed numerical sodium cloud model at AER. The modeling analysis has led to a number of definite conclusions regarding the local structure of Io's atmosphere, the gas escape mechanism at Io, and the presence of an east-west electric field and a System III longitudinal asymmetry in the plasma torus. Large scale stability, as well as some smaller scale time variability for both the sodium cloud and the structure of the plasma torus over a several year time period are also discussed.

31389 (N—88-20239) **To what extent is mass loading responsible for the Venus bowshock precursor?.** Fontheim, E.G.; Brace, L.H. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Mar 1988. 9p. (NASA-TM—89307; NAS—1.15:89307). NTIS, PC A02/MF A01.

Significant ion and electron flux enhancements immediately upstream of the Venus bow shock were observed by the Electron Temperature Probe on the Pioneer Venus Orbiter. It is shown that mass loading of the solar wind by oxygen ions accounts for only about 10 percent of the observed effect.

31390 (PB—88-179213/XAB) **Solar-Geophysical Data Number 521, January 1988. Part 1 (prompt reports). Data for December 1987, November 1987, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jan 1988. 108p. (SGD—521-PT-1). NTIS, PC A06/MF A01.

See also PB—88-164199 and PB—88-179221.

Contents include: Detailed index for 1987; Data for December 1987–(IUWDS alert periods (Advance and Worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for November 1987–(Solar-active regions, Sudden ionospheric disturbances; Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data–(Cosmic ray neutron monitor, Solar radio spectral observations).

31391 (PB—88-179221/XAB) **Solar-Geophysical Data Number 521, January 1988. Part 2 (comprehensive reports). Data for July 1987, and miscellanea.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Jan 1988. 53p. (SGD—521-PT-2). NTIS, PC A04/MF A01.

See also PB—88-179213, and PB—88-164207.

Contents include: Detailed index for 1987; Data for July 1987–(Meudon Carte Synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments); Miscellaneous data–Solar x-ray flare events May-December 1984.

31392 (RAL—87-109, pp 1-19) **Continuum emission in AGNs: a theoretical perspective.** Rees, M.J. (Cambridge Univ. (UK). Inst. of Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

A review is given of the forms of continuum radiation which are observed from active galactic nuclei and the attempts which have been made to model the processes involved. Confinement of the broad line emitting region is briefly discussed. (U.K.).

31393 (RAL—87-109, pp 20-34) **Ionizing X-ray to ultraviolet continuum of quasars.** Elvis, M. (Harvard-Smithsonian Center for Astrophysics, Cambridge, MA (USA)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Recent results on the soft x-ray spectra of quasars from the Einstein Observatory and EXOSAT have revealed a striking variety of forms. We review these results in the wider context of the optical/ultraviolet 'big bump'. We consider various forms for the unobservable (directly) EUV region of the quasar continuum. Possible accretion disk models are advanced and the dependence of the continuum form on the assumptions of the disk models is shown. The correlation of the x-ray spectra with other quasar properties is discussed. A relationship between optical FeII line strength and the shape of the ionizing x-ray continuum is presented.

31394 (RAL—87-109, pp 35-53) **Ultraviolet continuum of quasars.** O'Brien, P.T. (University Coll., London (UK). Dept. of Physics and Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

A brief review is presented of the properties of the ultraviolet continuum of quasars based primarily on IUE data. The shape and strength of the ultraviolet continuum is discussed, and also the possibility of intrinsic continuum reddening.

31395 (RAL—87-109, pp 54-78) **Probes of the broad line region.** Baldwin, J.A. (Ohio State Univ., Columbus (US). Dept. of Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Unravelling the nature of the broad line regions (BLR) associated with QSOs and active galactic nuclei (AGN) is proving to be a long and complicated process, requiring an iterative interaction between observation and theoretical modeling. The objectives of this line of research are to understand the nature of the emission-line clouds (condensations in outflowing winds? rotating disks of accreting gas? the atmospheres of fried stars?), the chemical composition of the gas, and to learn what, if anything, this gas can tell us about the power source of the active nucleus.

31396 (RAL—87-109, pp 79-98) **Broad emission line profiles of quasars.** Wilkes, B.J. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

The standard model for the broad emission line region of quasars is reviewed along with the observational data which led to this model. Studies of the line profiles of the various lines, which lead to dynamical and geometric information about the region, are summarized. Implications of these data are described in terms of modifications to the standard model. A selection of alternatives to this model are described to illustrate their diversity and demonstrate the lack of observational constraints with which to narrow down the possibilities.

31397 (RAL—87-109, pp 99-106) **Profile decomposition in active galactic nuclei.** Alloin, D. (Observatoire de Paris, Section de Meudon, 92 (France)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

In the field of active galactic nuclei (AGN), improved observational facilities have allowed the study of emission line profiles with resolutions down to 0.2 A. Getting some insight into the structure and kinematics of the AGN gaseous component requires a detailed analysis of line profiles from the various regions found in an

AGN. This paper considers the various approaches which have been developed for such analyses. (U.K.).

31398 (RAL—87-109, pp 107-115) **Quasar emission line regions: the standard model.** Ferland, G.J. (Ohio State Univ., Columbus (USA); Cambridge Univ. (UK). Inst. of Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

This review summarizes the current standing of the "Standard Model" of the broad line region. This model is an entirely spectroscopic one in the sense that it was designed to be capable of reproducing the observed emission-line spectrum in an astrophysically reasonable way. Its important features are: a) a central source of ionizing radiation; b) small clouds or filaments which are individually optically thick to low-energy ionizing radiation; c) energy input to these clouds is solely from photoionization; and d) a single set of cloud parameters (particle density and ionizing flux). The success of this model of the origin of broad emission lines is remarkably in view of this simplicity. Recent observations of slight redshift and profile differences between various emission lines now demand that the theoretical predictions be made more realistic. In particular, it is no longer possible to model the entire broad line region in terms of a single set of cloud parameters. The next step will be to model the full environment.

31399 (RAL—87-109, pp 116-131) **Problems of the standard model.** Collin-Souffrin, S. (Centre National de la Recherche Scientifique, 75 - Paris (France). Inst. d'Astrophysique). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

The standard photoionization model of the broad line emission region (BLR) in active galactic nuclei is considered. It is concluded that the structure of the BLR and its physical condition cast doubt on the standard model. Another possible model, which tries to include a global picture, is discussed. (U.K.).

31400 (RAL—87-109, pp 132-141) **Are there alternatives to the standard model.** Dyson, J.E.; Perry, J.J. (Manchester Univ. (UK). Dept of Astronomy; Cambridge Univ. (UK). Inst. of Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Some of the questions involved in formulating a self-consistent model for the broad emission line region in active galactic nuclei are discussed. (U.K.).

31401 (RAL—87-109, pp 142-159) **Relativistic beaming models and their relevance to the radio, optical and X-ray properties of quasars.** Browne, I.W.A. (Nuffield Radio Astronomy Labs., Jodrell Bank (UK)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Quasar emission line regions are probably not spherically symmetric so any measurement that might give an indication of the orientation of the region deserves attention. Relativistic beaming models may provide such a indicator. The radio evidence for beaming models is reviewed, as are correlations of the orientation indicator R (the ratio of core to extended radio emission) with optical and X-ray properties of quasars. Such correlations imply that in core-dominated (high R) radio quasars there is a significant orientation dependent component to the optical and X-ray continuum emission. A dependence of line equivalent width on R is expected and some evidence for this is found in the [OIII]5007, 4959A line data.

31402 (RAL—87-109, pp 160-165) **Relationship between emission line luminosity and beam power in radiogalaxies.** Rawlings, S.; Saunders, R. (Mullard Radio Astronomy Observatory, Cambridge (UK). Cavendish Lab.). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

We report the discovery of a strong correlation between the bulk power in the beams of classical double radiogalaxies and the luminosity of the narrow emission lines from the associated active nucleus. We discuss the implications for the fuelling of the central engine of radiosources, and for the relation between radiogalaxies, radio-loud quasars and radio-quiet quasars.

31403 (RAL—87-109, pp 166-178) **Statistical studies of AGNs.** Joly, M. (Observatoire de Paris, Section de Meudon, 92 (France)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Up to now it has not been possible to identify a set of independent parameters fully describing the activity and physical properties of Active Galactic Nuclei. One possible approach to shed light on this problem is a statistical analysis of the observable properties. For this purpose, some authors have compiled observational data on AGN from the literature. The catalog includes quasars, Seyfert 1 nuclei and BLRG. The results concerning the widths and the equivalent widths of the strongest spectral lines for about 400 objects are shown. In section II some correlations between line widths and luminosity are shown. In section III the determination of the central mass from line width is discussed. In section IV we present a summary of the known correlations between equivalent widths, line widths and luminosity. In the last section are given some marginal results concerning the FeII emission in AGN.

31404 (RAL—87-109, pp 179-194) **AGN models: problems and modifications.** Netzer, H. (Tel Aviv Univ. (Israel)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

This workshop comes at a crucial time in the study of AGN. On one hand there is better understanding of line and continuum emissing processes, with the hope of improving the modeling of the BLR. On the other hand, the newly reported line variability observations may force us to completely change our view of the BLR size and density, maybe even to abandon the idea of photoionization as the sole energy input source to the line emitting region. This review discusses several new developments related to the ionizing source and the inner structure of AGN. The following topics are addressed: The "FeII problem"; the energy budget and the shape of the EUV continuum; evidences for massive accretion disks; angle dependent photoionization models; the L/M relationship in AGN.

31405 (RAL—87-109, pp 195-215) **Variability in low-luminosity AGNs.** Petersen, B.M. (Ohio State Univ., Columbus (US). Dept. of Astronomy). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

One of the principal goals of the study of the broad-line region (BLR) in AGNs is determination of the velocity field of the gas. The dynamics of the BLR can reasonably be expected to reveal crucial information about the important physical processes within $\sim 10^{16}$ cm of the energy source in these objects. In this contribution, emission-line variability will first be addressed in terms of the "Standard Model". It will then be shown that in low-luminosity AGNs the standard model fails to predict the response time of the integrated broad-line fluxes by at least an order of magnitude. The use and limitations of cross-correlation analysis for determining the BLR radius from optical continuum and integrated line fluxes will be discussed in some detail. Finally, some of the important physical consequences of a very small BLR will be outlined.

31406 (RAL—87-109, pp 214-233) **Variability in high luminosity active galactic nuclei.** Gondhalekar, P.M. (Rutherford Appleton Lab., Chilton (UK)). May 1987. NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW. (CONF-8705281—).

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

The analysis of spectra of 34 quasars observed more than once with IUE is presented. The Lyα+NV and CIV lines in the spectra of some of these objects change in intensity over a time scale comparable to the time scale for changes observed in low luminosity active galactic nuclei. The data clearly suggest that the broad emission line region is considerably smaller than that required to model the emission line spectrum of active galactic nuclei. Also the broad line region does not appear to scale with luminosity as required by the present generation of models of the broad line region.

31407 **(RAL—87-109) Emission lines in active galactic nuclei.** Gondhalekar, P.M. (ed.). (Rutherford Appleton Lab., Chilton (UK)). May 1987. 233p. (CONF-8705281—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88753097/JAW.

From Rutherford Appleton Laboratory workshop on astronomy and astrophysics; Abingdon, UK (27 May 1987).

Fifteen papers cover continuum emissions in AGNs, theory and observations of broad emission lines and line and continuum correlations and variability. (U.K.).

31408 **(SI—87-01) Antiprotons production of propagating cosmic rays under distributed reacceleration.** Simon, M.; Heinbach, U.; Koch, C. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 7 - Physik). 1987. 19p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753586/JAW.

The available measurements on the cosmic ray anti p/p-ratio show an excess of antiprotons above predictions derived in the framework of the standard picture of cosmic ray origin and propagation. We calculated the anti p production from collisions of cosmic rays with the interstellar gas under the condition of distributed reacceleration. It could be shown that the calculated anti p/p-ratio is enhanced compared to that derived from the 'leaky box' model but it remains difficult to bring it into agreement with the data by reasonable astrophysical assumptions.

31409 **(UCRL—97950) Heavy ion collisions with A = 10^{57}: Aspects of nuclear stability and the nuclear equation of state in coalescing neutron-star binary systems.** Mathews, G.J.; Wilson, J.R.; Evans, C.R.; Detweiler, S.L. (Lawrence Livermore National Lab., CA (USA); California Inst. of Tech., Pasadena (USA); Florida Univ., Gainesville (USA)). Dec 1987. Contract W-7405-ENG-48. 8p. (CONF-871243—9).

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

The dynamics of the final stages of the coalescence of two neturon stars (such as the binary pulsar PSR 1913+16) is an unsolved problem in astrophysics. Such systems are probably efficient generators of gravitational radiation, and may be significant contributors to heavy-element nucleosynthesis. The input physics for the study of such systems is similar to that required for the strudy of heavy-ion collision hydrodynamics; e.g., a finite temperature nuclear equation of state, properties of nuclei away from stability, etc. We discuss the development of a relativistic hydrodynamics code in three spatial dimensions for the purpose of studying such neutron-star systems. The properties of the mass-radius relation (determined by the nuclear equation of state) may lead to a proposed mechanism by which hot, highly neutronized matter is ejected from the coalescing stars. This material is photodisintegrated into a free (mostly) neutron gas which may subsequently experience rapid-neutron capture (r-process) nucleosynthesis. 15 refs., 4 figs.

31410 **(UCRL—98253) Gamma rays from Cygnus X-1: Modeling and nonthermal pair production.** Dermer, C.D.;Liang, E.P. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 7p. (CONF-871245—3). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88006830/JAW.

From Workshop on nuclear spectroscopy of astrophysical sources; Washington, DC, USA (14 Dec 1987).

The gamma-ray bump observed between 0.5 and 2 MeV in the spectrum of Cygnus X-1 can be interpreted as the thermal emissions from a hot (kT{approximately}400 keV) pair-dominated cloud. We argue that the X-rays and gamma rays are produced in separate emission regions, and calculate the photon-photon pair production rate from X-ray and gamma-ray interactions in the vicinity of Cyg X-1 by employing a simplified geometry for the two emitting regions.

31411 **Resource Letter CPP-1:Cosmology and particle physics.** Lindley, D.; Kolb, E.W.; Schramm, D.N. (Theoretical Astrophysics Group, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *American Journal of Physics;* **56**: No. 6, 492-501(Jun 1988).

This Resource Letter provides a guide to the literature on cosmology and particle physics. The letter E after an item indicates elementary level or material of general interest to persons becoming informed in the field. The letter I, for intermediate level, indicates material of somewhat more specialized nature; and the letter A indicates rather specialized or advanced material. An asterisk (*) indicates those articles to be included in an accompanying Reprint Book.

31412 **Equation of state from nuclear and astrophysical evidence.** Glendenning, N.K. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2733-2743(Jun 1988).

Data on the nuclear equation of state from a number of different sources, from nuclei, high energy nuclear collisions, supernova, and neutron stars are analyzed. The current situation concerning supernova simulations is critically appraised. It is found that simulations that have achieved a prompt ejection do so with an equation of state that is too soft to support the measured masses of several known neutron stars. It is concluded that supernova explosions have not been proven to provide a significant constraint on the nuclear equation of state. Additionally it is concluded that the theoretical bias used to interpret data on neutron star masses as if they belonged to a population all having the same mass (of 1.4M/ sub sun/) is unjustified. Evidence from the various nuclear data and neutron star masses favor a high compression modulus, K≃300 MeV. No definitive statement can be made about the equation of state at higher density, save that the neutron star equation of state must be moderately stiff to accommodate neutron stars of mass ≃1.85M/sub sun/.

31413 **Primordial origin of nontopological solitons.** Frieman, J.A.; Gelmini, G.B.; Gleiser, M.; Kolb, E.W. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review Letters;* **60**: No. 21, 2101-2104(23 May 1988). Contract AC03-76SF00515.

We discuss the formation of nontopological solitons in a second-order phase transition in the early Universe. Ratios of dimensionless coupling constants in the Lagrangean determine their abundance and mass. For a large range of parameters, nontopological solitons can be cosmologically significant, contributing a significant fraction of the present mass density of the Universe.

31414 **Inflation-produced, large-scale magnetic fields.** Turner, M.S.; Widrow, L.M. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Ilinois 60510-0500). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 10, 2743-2754(15 May 1988).

We study the production of large-scale (~Mpc) magnetic fields in inflationary Universe models. The magnetic fields produced are uninterestingly small unless the conformal invariance of the electromagnetic field is broken. Once the conformal invariance

is broken, a mechanism akin to "superadiabatic amplification" can operate and lead to sizable primeval magnetic fields. We consider three ways of breaking the conformal invariance: through gravitational couplings of the photon; through the coupling of the photon to a charged massless, nonconformally invariant scalar field; and through the anomalous coupling of the photon to axions. The primeval magnetic fields which result can have astrophysically interesting strengths, but are very model dependent.

31415 **Quantum kinetic field theory in curved spacetime: Covariant Wigner function and Liouville-Vlasov equations.** Calzetta, E.; Habib, S.; Hu, B.L. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 2901-2919(15 May 1988).

We consider quantum fields in an external potential and show how, by using the Fourier transform on propagators, one can obtain the mass-shell constraint conditions and the Liouville-Vlasov equation for the Wigner distribution function. We then consider the Hadamard function $G_1(x_1,x_2)$ of a real, free, scalar field in curved space. We postulate a form for the Fourier transform F/sup (//sup Q//sup)/(X,k) of the propagator with respect to the difference variable $x = x_1-x_2$ on a Riemann normal coordinate centered at Q. We show that F/sup (//sup Q//sup)/ is the result of applying a certain Q-dependent operator on a covariant Wigner function F. We derive from the wave equations for G_1 a covariant equation for the distribution function and show its consistency. We seek solutions to the set of Liouville-Vlasov equations for the vacuum and nonvacuum cases up to the third adiabatic order. Finally we apply this method to calculate the Hadamard function in the Einstein universe. We show that the covariant Wigner function can incorporate certain relevant global properties of the background spacetime. Covariant Wigner functions and Liouville-Vlasov equations are also derived for free fermions in curved spacetime. The method presented here can serve as a basis for constructing quantum kinetic theories in curved spacetime or for near-uniform systems under quasiequilibrium conditions. It can also be useful to the development of a transport theory of quantum fields for the investigation of grand unification and post-Planckian quantum processes in the early Universe.

31416 **On the magnitude of baryon-to-photon ratio inhomogeneities resulting from a first-order quark-hadron transition.** Turner, M.S. (NASA/Fermilab Astrophysics Center, Fermi National Accelerator Laboratory, Batavia, Illinois 60510-0500). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3049-3051(15 May 1988).

We show that consideration of the low-lying baryon states in addition to the neutron and proton (specifically, the Λ, Σ, and Δ states) reduces the ratio of baryon-number density in the quark phase to that in the hadronic phase by more than a factor of 2. This implies that inhomogeneities in the local baryon-number-to-photon ratio produced during the quark-hadron transition are likely to be smaller than previous estimates, and therefore unless the transition temperature is less than ~150 MeV, the effects upon primordial nucleosynthesis will not be significant.

31417 **Inflation and invisible axions.** Dimopoulos, S.; Hall, L.J. (Department of Physics, Stanford University, Stanford, California 94305). *Physical Review Letters;* **60**: No. 19, 1899-1901(9 May 1988).

An era of inflation in the hot big bang can lead to a dilution of axions. Such a dilution removes the upper bound on f/sub A/, the symmetry-breaking scale at which axions are produced. The dilution may occur during or just after inflation, but in either case there is a restriction on the reheat temperature of the Universe after inflation. Hence, such a scenario for an invisible axion requires baryogenesis to occur at a low temperature.

31418 **Interplanetary magnetic field draping about fast coronal mass ejecta in the outer heliosphere.** McComas, D.J.; Gosling, J.T.; Winterhalter, D.; Smith, E.J. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A4, 2519-2526(1 Apr 1988).

Considerable recent research on the draping of the interplanetary magnetic field (IMF) about the ionospheres of comets and Venus and about the Earth's magnetosphere, as well as draping of magnetospheric fields about Io's ionosphere and plasmoids, has indicated the fundamental and prevalent nature of this process. In this paper we consider the possibility of magnetic field draping about fast coronal mass ejections (CMEs) which propagate into the outer heliosphere through slower moving, quiescent solar wind. In particular, when this velocity difference is appreciably greater than the local Alfven speed, draping should produce extended magnetotail-like configurations somewhat analogous to those observed behind Venus and comets. For CMEs, however, such tails would point sunward and form on scales comparable to these large ejecta. In the draped magnetotial regions sunward of fast CMEs in the outer heliosphere the IMF should be relatively radial, in contrast to the generally transverse orientation of the Parker spiral there. Low transverse flow velocities in the draped regions just upstream from fast CMEs suggest that swept-up interplanetary magnetic flux is hung up on these large structures (~1 AU in transverse dimension at 1 AU) for many days. We have searched for evidence of magnetic field draping about fast CMEs and the existence of large draped magnetotails in the outer heliosphere by examining the Pioneer 11 data set between 6.9 and 9.4 AU. Several events consistent with such structures have been found, and two are displayed in the study. copyright American Geophysical Union 1988

31419 **Comment on "Ion distributions in the dayside magnetosheaths of Jupiter and Saturn" by J. D. Richardson.** Thomsen, M.F.; Gosling, J.T. (Space Plasma Physics Group, Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A4, 2761-2762(1 Apr 1988).

It is pointed out that the double-humped ion distribution observed in the magnetosheaths of Jupiter and Saturn has also been seen in the terrestrial magnetosheath. (AIP)

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REFER ALSO TO CITATION(S) 31384, 31390, 31419

31420 **(AD-A—189105/0/XAB) Rocket-borne and ground-based measurements in support of the field-widened interferometer experiment - sergeant a30.276.** Ulwick, J.C.; Allred, G.D.; Baker, K.D.; Howlett, L.C. (Utah State Univ., Logan (USA). Space Dynamics Lab.). 28 May 1985. 100p. (SDL—85-032). NTIS, PC A05/MF A01.

In April 1983 Utah State University and Air Force Geophysics Laboratory experimenters launched a Sergeant (A30.276) sounding rocket from the Poker Flat Research Range, Alaska. The prime purpose of the flight was to obtain infrared-spectral measurements in the 2-1.5 micrometer m range during an auroral event. In addition to the prime experiment, which has already been reported, the payload contained four photometers, and energy deposition scintillator and an atomic oxygen detector to gather in-situ supporting data. Simultaneously, all-sky television, meridian scanning photometers, riometer, and magnetometers supported the flight from ground-based measuring sites. This report presents a summary of the rocketborne supporting instruments and the data they gathered and provides a time/intensity history of the event as documented by the ground-based meridian scanners and all-sky television.

31421 **(AD-A—189399/9/XAB) O I 3d (3)d(o) - (2)p(4) (3)p transition at 1026 A in the day airglow.** Meier, R.R.; Anderson, D.E.; Paxton, L.J.; McCoy, R.P. (California Univ., Berkeley (USA). Space Sciences Lab.). 1 Aug 1987. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A8, 8767-8773(1 Aug 1987).

An emission feature at 1026 A observed at 600 km in the dayglow with a spectrometer on board the STP 78-1 spacecraft cannot be explained by geocoronal hydrogen Lyman. An accidental resonance of some lines of the O I multiplet at 1026-A with the broad solar Lyman-beta line can in fact account for the observed emission rate, based on analysis with a Monte Carlo radiative transport model. Photoelectron excitation of atomic oxygen is negligible compared with resonant scattering. These airglow results support a

ratio of 66 to 1 for the solar Lyman-alpha to Lyman-beta line center fluxes.

31422 **(AD-A—189446/8/XAB) Measurements of trans-ionospheric propagation parameters in the polar-cap ionosphere. Final report, October 1982-November 1986.** Klobuchar, J.A.; Anderson, D.N.; Bishop, G.J.; Doherty, P.H. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 3 Apr 1987. 13p. (AFGL-TR—87-0121). NTIS, PC A03/MF A01.

Measurements of absolute TEC (Total Electron Content), were made for the first time from the polar-cap station located at Thule, Greenland in early 1984 using dual-frequency group delay measurements from high orbit satellites. Measurements of L-band amplitude scintillation and dual-frequency differential carrier-phase scintillation were also made. The variability of the TEC was extremely large, with increases above the background values of more than 100% observed frequently. Quasi-periodic TEC enhancements with periods as short as 10 min and with amplitudes exceeding 10**17 el/m**2 column were seen over several time intervals of more than two hours. The absolute values of TEC observed in the dark polar-cap ionosphere at times exceeded the diurnal maximum values from the mid-latitude ionosphere during this initial period of observations.

31423 **(AD-A—189562/2/XAB) E and F region study of the evening-sector auroral oval: a Chatanika/Dynamics Explorer 2/NOAA 6 comparison.** Senior, C.; Sharber, J.R.; De La Beaujardiere, O.; Heelis, R.A.; Evans, D.S. (Southwest Research Inst., San Antonio, TX (USA)). 1 Mar 1987. 20p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A3, 2477-2494(1 Mar 1987). Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

Simultaneous data obtained with the Chatanika incoherent-scatter radar and the Dynamics Explorer 2(DE2) and NOAA 6 satellites are used to relate the locations of the precipitating particles, field-aligned currents, and E and F region ionization structures in the evening-sector auroral oval. The auroral E layer observed by the radar extends about 2° equatorward of the electron-precipitation region, and its equatorward edge coincides with the equatorward edges of the region 2 field-aligned current and intense convection region (E approx. 50 mV/m). It is shown that precipitating protons are responsible for part of the E-region ionization within the electron-precipitation region as well as south of it. E-region density profiles calculated from ion spectra measured by the DE2 and NOAA 6 satellites are in fairly good agreement with the Chatanika data. In the F region, a channel of enhanced ionization density, elongated along the east-west direction and having a width of about 100 km, marks the poleward edge of the main trough. It is colocated with the equatorward boundary of the electron precipitation from the central plasma sheet. Although enhanced fluxes of soft electron are observed at this boundary, the energy input to the ionospheric electron gas, calculated from the radar data, shows that this ionization channel is not locally produced by this soft precipitation, but that it is rather a convected feature. In fact, both the trough and the ionization channel are located in a region where the plasma flows sunward at high speed, but the flux tubes associated with these two features have different convective time histories.

31424 **(AD-A—189588/7/XAB) Delayed entry of solar protons (E/sub p/ > 0.3 MeV) into the Earth's magnetotail.** Van Allen, J.A.; Saflekos, N.Z.; Sarris, E.T. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Nov 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Geophysics Research, Vol. 92, No. A11, 12115-12125(1 Nov 1987).

The delayed entry of solar protons (E/sub P/ > 0.3 MeV) into the Earth's magnetotail was studied by simultaneous observation with three Earth-orbiting spacecraft of specially favorable events during 1968. Principal findings are that (1) such protons have immediate access to the magnetosheath; (2) delay times increase discontinuously from essentially zero in the magnetosheath to tens of minutes as an observing point moves inward across the magnetopause; (3) well-defined delay times in the range 30-160 min occur for points interior to the magnetotail; (4) the inferred entry points lie at downstream distances of 80-500 R/sub E/; and (5) there is no discernible relationship between the direction and sense of the interplanetary magnetic field and the entry times in the northern and southern lobes of the magnetotail or the entry times at various distances from its central axis, the X/sub GSM/ axis. This data set is compatible with previously published work but adds significantly to observational knowledge of the subject. In broad terms, the results favor some form of an open model of the magnetotail and are inconsistent with diffusive entry of protons across a closed magnetotail field with a time constant substantially greater than a few minutes.

31425 **(AD-A—189624/0/XAB) Ultraviolet nightglow production near the magnetic equator by neutral-particle precipitation.** Abreu, V.J.; Eastes, R.W.; Yee, J.H.; Solomon, S.C.; Chakrabarti, S. (California Univ., Berkeley (USA). Space Sciences Lab.). 1 Oct 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 91, No. A10, 11,365-11,368(1 Oct 1986).

The near-modnight latitudinal (+/-45) distribution of the OI 911-A, 1304-A, and 1356-A emissions, observed by the extreme ultraviolet (EUV) spectrometer on the STP 78-1 satellite, were analyzed and compared as a function of geomagnetic activity. The dominant source of these emissions is radiative recombination of atomic oxygen ions; however, for geomagnetically distributed periods, excess OI 1304-A and 1356-A emission is observed within +/-5 of the dip equator. Neutral-particle precipitation from the ring current is discussed as a possible source of the excess OI 1304-A and 1356-A emission.

31426 **(AD-A—189742/0/XAB) Proposal for the establishment of a center of excellence in theoretical geoplasma research. Annual report No. 1, 1 October 1986-30 September 1987.** Chang, T. (Massachusetts Inst. of Tech., Cambridge (USA)). 15 Nov 1987. 55p. NTIS, PC A04/MF A01.

Original contains color plates: All DTIC/NTIS reproductions will be in black and white.

Research topics considered include: ionosphere-magnetosphere coupling, high-latitude ionospheric turbulence, charged-particle acceleration and heating, nonclassical polar wind, double layers, magnetic reconnection, strong MHD turbulence, plasma radiations induced by moving conducting objects in the low-altitude ionosphere, and F-region subvisual polar arcs. Partial Contents: Transverse Acceleration and Heating of Ionospheric Ions and the Formation of Ion Conics: Transverse Heating of Ionospheric Ions along Auroval Field Lines by Intense Electromagnetic; Turbulence in the Ion-Cyclotron Range of Frequencies; Acceleration of Ionospheric Ions by Lower Hybrid Waves in the Boundary Plasma Sheet; Two-Dimensional Particle-in-Cell Plasma Simulation of High-Latitude Lower Hybrid Turbulence and Charged-Particle Acceleration; Ionospheric-Magnetosphere-Solar Wind Coupling Processes; Study of Detailed Particle Distribution and Pitch Angle Scattering in the Diffuse Aurora; A New Nonclassical Polar-Wind Theory; and Plasma Radiations in the Low-Altitude Ionosphere due to Moving Conducting Objects.

31427 **(N—88-19395) Toward a comprehensive theory for the sweeping of trapped radiation by inert orbiting matter.** Fillius, W. (California Univ., San Diego (USA)). 1988. 35p. (NASA-CR—182584; NAS—1.26:182584). NTIS, PC A03/MF A01.

There is a need to calculate loss rates when trapped Van Allen radiation encounters inert orbiting material such as planetary rings and satellites. An analytic expression for the probability of a hit in a bounce encounter is available for all cases where the absorber is spherical and the particles are gyrotropically distributed on a cylindrical flux tube. The hit probability is a function of the particle's pitch angle, the size of the absorber, and the distance between flux tube and absorber, when distances are scaled to the gyroradius of a particle moving perpendicular to the magnetic field. Using this expression, hit probabilities have been computed in drift encounters for all regimes of particle energies and absorber sizes. This technique generalizes the approach to sweeping lifetimes, and is particularly suitable for attacking the inverse problem, where one is given a sweeping signature and wants to deduce the properties of the absorber(s).

31428 (N—88-20138) Investigation of low energy space plasma. Semiannual progress report, October-March 1988. Comfort, R.H.; Horwitz, J.L. (Alabama Univ., Huntsville (USA)). Apr 1988. 14p. (NASA-CR—182611; NAS—1.26:182611). NTIS, PC A03/MF A01.

Analysis techniques and software development, data analysis and modeling, laboratory plasma flow studies, meetings, and publications are presented.

31429 Streaming tearing instability in the current sheet with a super-Alfvenic flow. Wang, S.; Lee, L.C.; Wei, C.Q. (Geophysical Institute and Department of Physics, University of Alaska, Fairbanks, Alaska 99775-0800). *Physics of Fluids;* **31**: No. 6, 1544-1548(Jun 1988).

The tearing instability in a current sheet, which has a sub-Alfvenic or super-Alfvenic plasma flow in the current layer, is investigated based on the linearized compressible magnetohydrodynamic (MHD) equations. An initial-value method is employed to obtain the linear growth rate and eigenmode profiles of the fastest growing mode. The results show that for a sub-Alfvenic plasma flow parallel to the neutral sheet, the growth rate of the tearing instability is only slightly larger than that of the pure tearing mode without the flow. On the other hand, a large increase in the growth rate of the most unstable mode is observed, when the streaming speed V_0/sub m/ in the central region of the current sheet increases above a critical speed V/sub C/≅1.2V/sub A//sub ∞/. Here V/sub A//sub ∞/ is the Alfven speed far away from the current layer. This study shows that when the electric resistivity eta is zero, the sausage mode is excited because of a super-Alfvenic plasma flow parallel to the current sheet. This flow-induced sausage mode is called the streaming sausage mode. In the presence of a finite resistivity, the streaming sausage mode becomes a mixed sausage—tearing mode, because of the presence of magnetic field line reconnections in the current sheet. This mixed sausage—tearing mode, or simply the streaming tearing mode, has a high growth rate, γ≅0.1tau^{-1}/sub A/, where tau/sub A/ is the Alfven transit time across the current layer.

31430 Computer simulations of plasma expansion across a magnetic field. Galvez, M.; Gary, S.P.; Barnes, C.; Winske, D. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 6, 1554-1567(Jun 1988).

A two-dimensional electrostatic particle-in-cell code is used to simulate the thermal expansion of a cylindrical plasma across a uniform magnetic field. The simulations show that at early times (i.e., short compared to an ion gyroperiod), the plasma develops three characteristic regions: a charge neutral core surrounded by a negatively charged region (the electron charge layer), and an external halo composed only of ions (the ion charge layer). The radii of these non-neutral regions increase when either the electron plasma to electron cyclotron frequency ratio ω/sub p//sub e/chemical bondΩ/sub e/chemical bond increases or when the electron to ion temperature ratio, T/sub e/T/sub i/, decreases. These simulations, which have been run with an ion-to-electron mass ratio of 100, show that the plasma develops structure as a result of the growth of a nonoscillatory instability in the electron charge layer. This structure exhibits growth times short compared to the ion gyroperiod, and wavelengths of the order of the ion gyroradius. The mode number of this structure increases with decreasing ω/sub p//sub e/chemical bondΩ/sub e/chemical bond, with increasing initial radius of the plasma relative to the electron Debye length, and with increasing T/sub e/T/sub i/. The linear theory of the lower hybrid drift instability, driven by the E x B and deln x B electron drift velocities, provides a good description of the parametric variation of the structure wavelength. It is therefore concluded that this instability is the most likely source of the structure observed in these simulations.

31431 Hadronic transitions of D-wave quarkonium. Moxhay, P. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 9, 2557-2563(1 May 1988).

The decays Y(1D)→Yππ are calculated within the framework of the multipole expansion in QCD. Using a description of the conversion of gluons into pions based on soft-pion theorems, we find Γ(Y(1 ^{3}D/sub J/)→Yππ) = 0.07 keV; the rates are identical for J = 1,2,3. The smallness of these rates means that the ^{3}D states can probably only be observed using their electric-dipole transitions Y(1D)→Y(1P)γ. .AE

31432 Short-wavelength modes on expanding plasma clouds. Winske, D. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A4, 2539-2552(1 Apr 1988).

It is proposed that the short-wavelength (less than an ion gyroradius) flute modes observed on the surface of expanding plasma clouds, such as the Active Magnetospheric Particle Tracer Explorers (AMPTE) barium releases in the magnetotail, can be explained in terms of the lower hybrid drift instability, which in its general form includes an electron-ion drift induced by the deceleration of the plasma across a magnetic field. Similar types of structure are also seen in laser and theta pinch experiments and in recent simulations modeling these phenomena. Analytical and numerical solutions of the linear dispersion relation are given for a number of parameters. The linear theory reproduces the growth rate scaling of Hassam and Huba in the long-wavelength limit and indicates that maximum growth occurs at shorter wavelengths. The growth of the modes is illustrated by particle simulations showing that the instability is excited at early times, remains locked in at a fixed mode number, and because it continues to be driven by the deceleration, grows to amplitudes far larger than expected from usual ion trapping arguments. Issues related to the linear mode structure and the nonlinear evolution of the instability in the context of AMPTE are also discussed. copyright American Geophysical Union 1988

31433 Noncoplanar magnetic fields at collisionless shocks: A test of a new approach. Gosling, J.T.; Winske, D.; Thomsen, M.F. (Los Alamos National Laboratory, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A4, 2735-2740(1 Apr 1988).

Within the foot and ramp of a fast mode collisionless shock the magnetic field rotates out of the plane of coplanarity defined by the upstream magnetic field and the shock normal. As previously noted (Goodrich and Scudder, 1984), the sense of this rotation is such as to reduce the cross-shock potential drop when measured in the deHoffman-Teller frame relative to that measured in the normal incidence frame. From a consideration of the requirement that there be zero current in the coplanarity plane downstream of the shock, Jones and Ellison (1987) have argued that the field rotation and potential drop difference are a consequence of unequal ion and electron masses, and have derived an expression for the spatial integral of the noncoplanar field component in terms of the electron current within the shock layer. Moreover, by assuming that the ion current within the shock layer is negligible compared to the electron current, they derive equations which predict the magnitude of both the field rotation and the potential drop difference in terms of upstream quantities and the field jump at the shock. We have tested their equations with ISEE 1 and 2 plasma and field measurements at the Earth's bow shock and by means of numerical simulations. We find substantial support for their suggestion that the field rotation and thus also the frame dependence of the potential drop are fundamentally a consequence of unequal ion and electron masses. Further, for subcritical shocks (low Mach number) one can neglect the ion current to predict both the sign and the magnitude of the field rotation and potential drop difference. However, at supercritical shocks (high Mach numbers) the ion current associated with reflected, gyrating ions cannot be neglected, and the final equations of Jones and Ellison seriously underestimate the magnitude of the field rotation and the potential drop difference at these shocks.

31434 Interplanetary magnetic field orientations associated with bidirectional electron heat fluxes detected at ISEE 3. Stansberry, J.A.; Gosling, J.T.; Thomsen, M.F.; Bame, S.J.; Smith, E.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico). *Journal of Geophysical Research;* **93**: No. A3, 1975-1980(1 Mar 1988).

A statistical survey of interplanetary magnetic field orientations associated with bidirectional electron heat fluxes observed at ISEE 3 in orbit about the Sunward Lagrange point indicates that magnetic connection of the spacecraft to the Earth's bow shock

was frequently the source of the bidirectionality. When the interplanetary magnetic field was oriented within 5° of the Earth-spacecraft line, backstreaming electrons from the bow shock were clearly observed approximately 18% of the time, and connections apparently occurred for angles as large as ~30°—35°. copyright American Geophysical Union 1988

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REFER ALSO TO CITATION(S) 30533, 30767, 31736, 31741, 31771, 31790, 31859, 31893, 31948

31435 (AD-A—189091/2/XAB) Electron-stimulated desorption and coherent electron scattering. Interim technical report. Sambe, H.; Ramaker, D.E.; Parenteau, L.; Sanche, L. (George Washington Univ., Washington, DC (USA). Dept. of Chemistry). Dec 1987. 5p. (TR—40). NTIS, PC A02/MF A01.

The authors studied electron-stimulated 0(-) desorption from O_2 condensed on thick rare-gas (Ar, Kr, or Xe) films, which were previously deposited on a Pt substrate. For ordered rare-gas layers with a fixed O_2 coverage, the 0(-) yield increases almost linearly as the thickness of the rare gas layer increases, particularly near the Bragg reflection energies. This is shown to arise from coherent scattering of electrons in the rare-gas film.

31436 (AD-A—189436/9/XAB) Rydberg atoms and radiation. Report for January-December 1986. Kleppner, D.; Hughey, B.; Gentile, T.; Hilfer, E.; Vianna, S. (Massachusetts Inst. of Tech., Cambridge (USA). Research Lab. of Electronics). Jan 1987. 5p. NTIS, PC A02/MF A01.

The authors achieved their initial goal in the study of basic radioactive processes using Rydberg atoms - the observation of inhibited spontaneous emission. An experiment was carried out demonstrating that spontaneous emission can be effectively turned off. The underlying principle is that spontaneous emission results from the radioactive coupling between matter and a continuum of vacuum states. However, the assumptions underlying the conventional calculation of the density of modes in free space are not always valid. In particular, cavities can dramatically effect spontaneous emission. Such effects are difficult to observe in the optical regime because of the problem of making good fundamental mode cavities at short wavelengths. Excellent cavities can be made at microwave wavelengths, but spontaneous emission is enhanced by a factor of n4 where n is the principal quantum number, allowing such effects to be studied.

31437 (AD-A—189531/7/XAB) Asymptotically correct collisional presheaths. Report for 1 September 1985-19 August 1987. Main, G.L. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). Jun 1987. 14p. NTIS, PC A03/MF A01.

Pub. in The Physics of Fluids, Vol. 30, No. 6, 1800-1809(Jun 1987).

Few exact solutions for collisional presheaths exist because of the difficulty of simultaneously satisfying both the collisional Boltzmann equation and the Poisson equation. The exact solutions that do exist are for very specialized collision terms such as constant cross-section charge exchange with cold neutrals. This paper presents an asymptotic method which is applicable to a variety of collision terms and is applied in particular to constant collision-frequency charge exchange with noncold neutrals. Constant collision frequency and constant cross-section collision with cold-neutral results are also presented. The first order terms for the presheath potential rise and ion distribution functions are calculated and it is shown that second- and higher-order terms can be calculated using a multiexponential expansion for presheath potential rise. The first-order cold-neutral constant cross-section results correspond well to the exact solution. The calculated presheath potential rises are of the order expected from the Bohm criterion, and in some of the specialized cold-neutral cases, exactly k/sub e/2. The presheath potential rise is reduced by a neutral-plasma potential gradient that accelerates ions toward the presheath. In all cases the collisional presheath is asymptotically matched to both the neutral plasma and the collisionless sheath.

31438 (BNL—41035) Static magnetic ordering of CeCu/sub 2.1/Si_2 found by muon spin relaxation. Uemura, Y.J.; Kossler, W.J.; Yu, X.H.; Schone, H.E.; Kempton, J.R.; Stronach, C.E.; Barth, S.; Gygax, F.N.; Hitti, B.; Schenck, A.; Baines, C.; Lankford, W.F.; Onuki, Y.; Komatsubara, T. (Brookhaven National Lab., Upton, NY (USA); College of William and Mary, Williamsburg, VA (USA). Dept. of Physics; Virginia State Univ., Petersburg (USA); Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. for Intermediate Energy Physics; Paul Scherer Inst. (PSI), Villigen (Switzerland); George Mason Univ., Fairfax, VA (USA); Tsukuba Univ., Sakura, Ibaraki (Japan). Inst. of Materials Science). 1988. Contract AC02-76CH00016. 4p. (CONF-880206—5).

From International conference on high temperature superconductors and materials and mechanisms of superconductivity; Interlaken, Switzerland (29 Feb 1988).

Zero- and longitudinal-field muon spin relaxation measurements on a poly-crystal sample of a heavy-fermion superconductor CeCu/sub 2.1/Si_2 (T/sub c/ = 0.7 K) have revealed an onset of static magnetic ordering below T {approximately} 0.8 K. The line shapes of the observed spectra in zero field indicate a wide distribution of static random local fields at muon sites, suggesting that the ordering is either spin glass or incommensurate spin-density-wave state. The observed width of the random local field at T = 0.05 K corresponds to a small averaged static moment of the order of 0.1 μ/sub B/ per formula unit.

31439 (CENBG—8706) Forward-angle scattering and nuclear-resonance effect in capture in H + N collisions. Oubaha, H.; Scheurer, J.N.; Andriamonje, S.; Azaiez, F.; Bertault, D.; Chemin, J.F. (Bordeaux-1 Univ., 33 - Gradignan (France). Centre d'Etudes Nucleaires). Jul 1987. 2p. (CONF-870715—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753062/JAW.

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

31440 (CERN-EP—86-145) The on-line resonance ionization mass spectroscopy of short-lived isotopes. Bollen, G.; Dohn, A.; Kluge, H.J.; Kroenert, U.; Wallmeroth, K. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik; European Organization for Nuclear Research, Geneva (Switzerland)). 7 Oct 1986. 11p. (CONF-8609132—17).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

On-line resonance ionization mass spectroscopy (RIMS) is discussed in order to study short-lived isotopes produced at on-line isotope separators. We report on a first application of RIMS to a determination of the isotope shift and hyperfine structure of $^{188-189}$Au and the I {equals} 112 isomer of ^{189}Au in the 6s $^2S_12 \rightarrow$ 6p $^2P_12$ (λ {equals} 268 nm) transition. The Au atoms were obtained as daughters of mass-separated Hg isotopes produced at the ISOLDE facility at CERN. 20 refs., 7 figs., 2 tabs.

31441 (DOE/ER—13792-1) Half collision studies of inelastic energy transfer processes. Lester, M.I. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). 1988. Contract FG02-87ER13792. 19p.

A new method is being developed for exploring inelastic collisional energy transfer events. These experiments rely on examining the unimolecular dissociation dynamics of OH-Rg vdW (Van der Waals) complexes in the X^2 {Pi} and $A^2\Sigma^+$ states. The inelastic half collision transfers vibrational (andor rotational) excitation, initially localized in OH internal motions, to translational recoil of the separating fragments and rotational excitation of OH. The collision partners start at close range and separate along the same potential energy surface sampled in full collisions. The complete determination of the internal state distribution of the products will allow the potential energy surface for the OH-rare gas interaction to be fully defined. The nascent rotational state distribution of the OH fragment is expected to reflect the final interaction between OH and the rare gas atom. Comparisons will be made between full and half collision dynamics in both the X and A states. 15 refs.

31442 (DOE/ER/13568—T1) [Theoretical studies of dynamics combustion]: Progress report. Bowman, J.M. (Emory Univ., Atlanta, GA (USA). Dept. of Chemistry). [1988]. Contract FG05-86ER13568. 25p.

Progress has been made in several areas of gas-phase collision dynamics of relevance to combustion processes. The new initiative in recombination dynamics has led to a detailed quantum and quasiclassical characterization of the long-lived resonance states of HCO. In addition, work has begun on high energy H {plus} CO scattering, which is providing additional insight into the interaction dynaimcs. Work has continued on reduced dimensionality approaches to three-dimensional reactive scattering, and the latest comparison with accurate quantum calculations continues to demonstrate the accuracy of the approach. A formal study of energy transfer extending the quantum forced-oscillator model was completed, and this work may find future use in the study of energy transfer from highly excited polyatomic molecules, and may even bear on stabilization dynamics in recombination. 20 refs., 9 figs., 4 tabs.

31443 (DOE/ER/13590—2) Multiphoton ionization spectroscopy and photochemistry of transient species: Annual progress report, July 15, 1987-July 15, 1988. Johnson, P.M. (State Univ. of New York, Stony Brook (USA)). Jul 1988. Contract FG02-86ER13590. 6p.

Our work is primarily focused on the resonance ionization spectroscopy of small molecules and radicals in supersonic beams. The current work has concentrated on two diatomic molecules (nitrogen and iodine) which form prototype systems in ths study of molecular structure, but whose higher excited states are incompletely known.

31444 (DOE/ER/13596—9) Double electron capture in $^3He^{2+}$ + He($1s^2$) collisions at intermediate velocities (vv/sub e/ {approximately} 1-3 au) using two-center AO+ method. Jain, A.; Lin, C.D.; Fritsch, W. (Kansas State Univ., Manhattan (USA). Dept. of Physics; Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik). 1987. Contract FG02-86ER13596. 2p. (CONF-870715—8).

From 15. international conference on the physics of electronic and atomic collisions; Brighton, UK (22 Jul 1987).

none

31445 (DOE/ER/13596—12) Atomic physics of strongly correlated systems. Lin, C.D. (Kansas State Univ., Manhattan (USA). Dept. of Physics). 1987. Contract FG02-86ER13596. 3p. (CONF-870595—3).

From DOE/BES atomic physics program workshop; Cambridge, MA, USA (21 May 1987).

This report summarizes the progress made in our study of strongly correlated systems since the last DOE/BES Atomic Physics Program Workshop and addresses our future plans. The report is divided into two parts: the study of electron correlations and the classification of multiply excited states of atoms; the theroetical study of charge transfer processes in ion-atom collisions.

31446 (DOE/ER/13596—T1) Atomic physics of strongly correlated systems: Progress report, 1 March 1987-1 March 1988. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Mar 1988. Contract FG02-86ER13596. 8p.

In the following paper we briefly summarize some of these results: double Rydberg Formula and applications to doubly excited states of multiply charged ions; classification of triply excited states or atoms from a molecular viewpoint; density matrix description for the hydrogenic n = 2 and 3 excited states formed in proton-helium collisions; theory of anisotropy transfer and calculations of alignment of excited states; angular distributions for charge transfer processes in ion-atom collisions; and finite-basis-set expansion method for inner shell ionization in ion-atom collisions.

31447 (DOE/ER/13751—1) Theoretical atomic and molecular physics: Progress report, July 1, 1987-June 30,1988. Lane, N.F. (Rice Univ., Houston, TX (USA)). 29 Feb 1988. Contract FG05-87ER13751. 12p.

In this first year of the grant, emphasis has been placed on theoretical investigations of: differential elastic and charge-transfer scattering and alignment and orientation of the excited electron cloud in ion-atom, atom-atom and ion-molecule collisions, using a molecular-orbital representation; quenching of low-lying Rydberg states of a Na atom in a collision with a ground-state He atom, using a semiclassical representation; chemiionization and ion-pair formation in a collision of a Li atom with a metastable He atom at intermediate collision energies, using a combination of quantal and semi-classical methods; Penning ionization of alkali atoms K and Rb, using advanced Cl and Stieltjes imaging methods; radiative and nonradiative charge-transfer in He^+ + H collisions at ultra-low collision energies, using quantal methods; charge-transfer in ion-atom, ion-molecule, and ion-surface-atom collisions at intermediate energies, using semi-classical methods; and elastic and inelastic processes in electron-molecule collisions, using the continuum-multiple-scattering (CMS) method. Selected highlights of the research progress are briefly summarized in the following sections.

31448 (EGG-M—12887) High-intensity positron beam via 200 MW/sub th/, large-volume, test (fission) reactor. Ottewitte, E.H. (Idaho National Engineering Lab., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 10p. (CONF-880171—1).

From BB factory workshop; Los Angeles, CA, USA (26 Jan 1988).

Several new applications require positron beam intensities of 10^{12}-10^{15} e/sup {plus/}s. Coventional technques can produce beam intensities of 10^8-10^9 e/sup {plus/}s. Neutron activation of large volumes of positron-emitting radioisotopes via a test (fission) reactor could produce positron source strengths of 10^{16}-10^{18}, e/sup {plus/}s, before collimation and cooling. A number of techniques offer reasonable efficiencies for achieving the desired beam intensities. 11 refs., 5 figs., 3 tabs.

31449 (IC—87/285) Breakdown of molecular oxygen by brief pulses of laser radiation. Gamal, Y.E.E.D. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702687/JAW.

We report a numerical analysis for the combined action of multi-photon (MPHI) and Cascade ionization (CI) processes in producing ionization and breakdown of molecular oxygen. The calculations were carried out at two different laser pulses of wavelengths 0.6943μm and 0.53μm with pulse durations 18ps and 25ps respectively, over a pressure range of 10^3-$5x10^4$ Torr. A reasonably good agreement has been obtained between the computed threshold intensities and the measured ones. Computations for nitrogen irradiated with 0.53μm are also given. This analysis shows that the model is capable to interpret gas breakdown experiments with short flashes of laser radiation. (author). 6 refs, 5 figs.

31450 (IC—87/290) Theory of resonant photo-ionization in the two-electron systems. Wague', A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702692/JAW.

In this report, a brief overview of the most current theoretical approximations, describing the resonant photo-ionizations in helium-like systems is presented: the Fano theory of resonant photo-ionization, close coupling approximation, diagonalization approximation, method of complex rotation and hyperspherical coordinate method. Some results of our calculations in diagonalization approximation and other theoretical calculations are shown together with experiment. (author). 39 refs, 3 figs, 2 tabs.

31451 (IC—87/323) Gyromagnetic factor and spin-orbit coupling of ligand in $CsVX_3$ (X=Cl, Br, I). Du Maolu; Zhao Minguang. (International Centre for Theoretical Physics, Trieste (Italy); Sichuan Normal Univ., Chengdu (China). Inst. of Solid State Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702716/JAW.

In the present work, the perturbation expression of the gyromagnetic factor of d^3 ions including the spin-orbit coupling of the ligand ions and the effect of the other excited states besides $^4T_1$

state is derived. The molecular orbital coefficients are determined with a semiempirical method to estimate the g shift. The results show that the contribution of the spin-orbit coupling of the ligand ions to g shift must be considered for some ligand ions possessing large spin-orbit coupling constant. The differences of the g shift between the theoretical and observed values in $CsVX_3$ are explained quantitatively. (author). 11 refs, 3 tabs.

31452 **(IC—87/327) Inverse scattering approach to the physics of transition metals.** Oli, B.A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702720/JAW.

A method is developed for the deduction of a transition metal ion potential from a knowledge of the phase-shift n/sub l/(k). The method used is based on the distorted plane-wave scattering approximation for the deduction of non-singular potentials from scattering phase-shifts in an inverse scattering approach. The resulting electron-ion potential obtained is a finite Dirichlet series sum of short range exponential functions. The Fourier transform of the potential is obtained for applications in the area of transition metal solid state physics. (author). 14 refs, 1 tab.

31453 **(IC—87/349) Double photon electric dipole and quadrupole absorption of atomic hydrogen.** Yu Song. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702736/JAW.

The two photon processes with one electric dipole photon and another electric quadrupole photon are investigated. These processes with selection rules different from two-electric dipole photon process may be tested by experiments with high power lasers. (author). 3 refs, 2 figs.

31454 **(INIS-BR—1004) Lithium photoionization cross-section and dynamic polarizability using square integrable basis sets and correlated wave functions.** Hollauer, E.; Nascimento, M.A.C. (Rio de Janeiro Univ. (Brazil). Inst. de Quimica). 1985. 7p. (CONF-8512147—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702588/JAW.

From 3. Brazilian symposium on theoretical chemistry; Sao Carlos, Brazil (9 Dec 1985).

The photoionization cross-section and dynamic polarizability for lithium atom are calculated using a discrete basis set to represent both the bound and the continuum-states of the atom, to construct an approximation to the dynamic polarizability. From the imaginary part of the complex dynamic polarizability one extracts the photoionization cross-section and from its real part the dynamic polarizability. The results are in good agreement with the experiments and other more elaborate calculations

31455 **(INIS-BR—1030) Photoionization cross-sections using the polarization propagator approach.** Nascimento, M.A.C. (Rio de Janeiro Univ. (Brazil). Inst. de Quimica). 1985. 6p. (CONF-8512147—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702294/JAW.

From 3. Brazilian symposium on theoretical chemistry; Sao Carlos, Brazil (9 Dec 1985).

It is shown that the imaginary part of the polarization propagator (PP), when computed at complex frequencies, w+i eta, can be, in the limit eta -> 0, directly related to the photoionization cross-section. Total photoionization cross-sections can be evaluated directly from the PP, and partial croos-sections can be computed from individual excitation frequencies and transition moments, using the spectral representation of the PP. For complex frequencies not only the real part of the PP but also its imaginary part is propotional to the complex dynamic polarizability.

31456 **(LA-UR—88-669) High-energy laser-assisted imaging through vaporizing aerosols.** Zardecki, A.;Gerstl, S.A.W. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 13p. (CONF-880462—6).

From SPIE's technical symposium on optics, electro-optic and sensors; Orlando, FL, USA (4 Apr 1988).

The degradation of image quality due to multiple scattering in a turbid medium is analyzed various conditions of illumination. The emphasis is on the forward-peaked multiple scattering effects, which can adequately be described by the small-angle approximation. In the case of incoherent illumination, the modulation transfer function (MTF) can be given explicity both in the low- and high-frequency limits. For scattering with smaller degree of anisotropy, the MTF should be imputed numerically by considering numerical by considering solutions to the equation of radiative transfer with a line or point source. As the beam power increases, the turbid medium becomes modified by its interactions with the beam, thus affecting the image resolution. In this nonlinear transport regime (flux levels of the order of 10^6 Wcm^2 and higher) the propagation leads actually to beam narrowing. In the context of the imaging problem, an apparent paradosical situation in which the image of a point source narrows down as the high-energy laser (HEL) beam propagates is discussed. 14 refs., 12 figs.

31457 **(LBL—21999-Rev.) Multiply stripped ion generation in the metal vapor vacuum arc.** Brown, I.G.; Feinberg, B.; Galvin, J.E. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 32p.

We consider the charge state distribution of ions produced in the metal vapor vacuum arc plasma discharge. A new kind of high current metal ion source in which the ion beam is extracted from a metal vapor vacuum arc plasma has been used to obtain the spectra of multiply charged ions produced within the cathode spots. The cathode materials used and the species reportetd on here are: C, Mg, Al, Si, Ti, Cr, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, Rh, Pd, Ag, In, Sn, Gd, Ho, Ta, W, Pt, Au, Pb, Th, and U; the arc current was 200 A for all measurements. Charge state spectra were measured using a time-of-flight method. The arc voltage was also measured. In this paper we report on the measured charge state distributions and arc voltages and compare the distributions with the predictions of a theory in which ionization occurs in the cathode spots via stepwise ionization by electron impact. 64 refs., 10 figs., 3 tabs.

31458 **(LBL—24636) XUV source for ultra-high resolution photoionization spectroscopy.** Cromwell, E.; Kung, A.H.; Trickl, T.; Lee, Y.T. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC02-76CH00016. 11p. (CONF-880110—27).

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

A tunable vuv-xuv laser system with good pulse energy (>100mJ in the visible) and narrow bandwidth (<210MHz in the xuv) was built in order to do ultra-high resolution photoionization spectroscopy. The capabilities of this system have been demonstrated with a study of isotope shifts and hyperfine splitting in Kr Rydbeg levels.

31459 **Reverse field injection for the gradient B drift transport of a high-current electron beam.** Lee, J.R.; Faucett, D.L.; Halbleib, J.A.; Hedemann, M.A.; Stygar, W.A. (Sandia National Laboratories, P. O. Box 5800, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **64**: No. 1, 12-20(1 Jul 1988).

Reverse field injection was used to inject a 0.9-MeV electron beam produced in a ring diode into a drift tube. The annular beam then was transported distances of up to 183 cm by gradient B drift in an applied magnetic field. The electron beam struck a tantalum target at the end of the drift tube, producing bremsstrahlung x-rays. An electron beam current of 1.1 MA was inferred from measurements of x-ray production in the target. This implies an injection efficiency of 69%.

31460 **Production of atomic or molecular nitrogen ion beams using a multicusp and a microwave ion source.** Walther, S.R.; Leung, K.N.; Kunkel, W.B. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **63**: No. 12, 5678-5682(15 Jun 1988). Contract AC03-76SF00098.

Two small ion sources have been used to generate positive nitrogen ion beams. One is a multicusp ion source, the other is a compact microwave ion source which needs no magnetic field for operation. Both sources are operated with and without a magnetic

filter to control the energetic electron population near the extraction region. Results for both ion sources, including current densities and ionic species mix are presented. The multicusp ion source can produce beams of nitrogen ions with greater than 90% of the ion species either N^+ or N^+_2 with current densities of ~8 and 2.5 mA/cm², respectively. The microwave ion source can generate nitrogen ion beams composed of more than 85% N^+_2 with current densities of ~30 mA/cm².

31461 IR spectrum of ethylene in solid xenon: Host—guest mode coupling. Collins, S.T.; Casey, P.A.; Pimentel, G.C. (Chemistry Department, California State University, Northridge, California 91330). *Journal of Chemical Physics;* **88**: No. 12, 7307-7311(15 Jun 1988).

Ethenes (C_2H_4, C_2D_4, cis-1,2-$C_2D_2H_2$, and trans-1,2-$C_2D_2H_2$) isolated in xenon matrices show dramatic and reversible infrared spectral changes between 12 and 50 K; most bands broaden with increasing temperature. In the xenon matrix, the C_2H_4 ν_7 band is unusually broad, much broader than in the argon spectrum, while the corresponding C_2D_4 mode remains sharp. Though sharper than C_2H_4 ν_7, many other bands are doublets in which one peak shows different temperature dependence than the other. The C_2D_4 ν_7 band, however, is only a singlet. Among several possible explanations for the unusual breadth, the most likely is that C_2H_4 ν_7 couples with the xenon lattice phonon modes through the librational movement of C_2H_4 within the cage. The doublets are attributed to two sites with which different modes and isotopes interact to varying degrees.

31462 Molecular-orbital description of the states of two-electron systems. Feagin, J.M.; Briggs, J.S. (Department of Physics, California State University, Fullerton, California 92634). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 12, 4599-4613(15 Jun 1988).

The molecular-orbital (MO) method introduced previously by us [Phys. Rev. Lett. 57, 984 (1986)] to treat two-electron atoms is developed further. The states of systems consisting of two electrons and one positively charged particle are analyzed with use of the interelectronic distance as an adiabatic coordinate in analogy to the interprotonic distance in H_2^+. The motion of two electrons then separates into rotational, vibrational, and internal motion, the latter being described by MO, exactly as in molecules. Indeed, adiabatic MO potential curves for atomic systems are obtained by scaling the corresponding curves for H_2^+. Approximate quantum numbers for two-electron states, derived previously by empirical methods or from an ad hoc rovibrational model, arise naturally since the two-center Coulomb problem is exactly separable in MO coordinates and the corresponding nodal surfaces are conserved for all interelectronic separations. In addition, the gerade-ungerade symmetry of MO is exactly preserved and appears as a fundamental symmetry of two-electron states.

31463 Nonperturbative analysis of the two-level atom: Applications to multiphoton excitation. Duvall, R.E.; Valeo, E.J.; Oberman, C.R. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08544). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 12, 4685-4693(15 Jun 1988).

Excitation of an atomic system subjected to a slowly varying external electromagnetic field is studied using a two-level model. Time evolution of the system is found using an approach which is nonperturbative in the field strength. There is no constraint to small values of the applied field, that is, the field (in appropriate energy units) need not be small compared to the difference in energies of the two levels. Rather, we use the fact that the situation of interest to us is where the frequency of the exciting field is small compared to the frequency associated with the level difference. Transition probabilities and resonance conditions are found which circumscribe both the large- and small-field limits. In the weak-field limit the previous results of high-order perturbation theory are readily recovered. For a monochromatic field the characteristic features of resonance excitation at high harmonic number of the applied field are (a) extremely narrow resonance widths and (b) shifts in resonance positions which are strong functions of field intensity. Because of this sensitivity, we are able to demonstrate that when slow temporal evolution of the field amplitude is taken into account (e.g., due to finite pulse duration) the appropriate mean excitation rate is that due to the uncorrelated contribution of many resonances. The results of this analysis are used to estimate excitation rates in a specific atomic system, Cd^{13+}, which are then compared to multiphoton-ionization rates. Our calculations suggest that the ionization rate exceeds the excitation rate by several orders of magnitude.

31464 Role of the Coulomb interaction in the low-frequency density of states of DNA double helices. Garcia, A.E.; Krumhansl, J.A. (Theoretical Biology and Biophysics Group (T-10), Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 12, 4875-4878(15 Jun 1988).

The complete vibrational frequency spectrum of several DNA double-helical oligomers is calculated using established pair potentials. Various cutoff values are used for the range of the Coulomb interactions. At very low frequency the integrated density of states shows a noninteger exponent with values ranging from 0.75 to 1.55, depending on the cutoff value for the Coulomb interactions. We conclude that the cumulative densities of states in those molecules depend more on competing interactions than on various proposed universal laws.

31465 Angular dependence of multiple-electron capture in 90-keV Ne^{7+}-Ne collisions. Schmidt-Boecking, H.; Prior, M.H.; Doerner, R.; Berg, H.; Pedersen, J.O.K.; Cocke, C.L.; Stockli, M.; Schlachter, A.S. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 12, 4640-4648(15 Jun 1988).

Multiple-electron capture as a function of the projectile scattering angle in 90-keV Ne^{7+} collisions on Ne atoms was investigated in the angular range from 1 to 20 mrad by a recoil-ion—projectile coincidence technique which records the final charge states of both product ions. A single-electron-capture probability P/sub SC/(θ) is determined, which, with application of binomial statistics, provides a good description of measured charge-state distributions for $\theta < 10$ mrad. For scattering angles $\theta > 10$ mrad, projectile and recoil-ion charge-state distributions are nearly identical, indicating full participation of all L-shell electrons in quasimolecular states. Nearly all electron-capture processes are followed by autoionization, indicating the importance of capture into multiply excited states. We observed a strong angular dependence of the autoionization probabilities.

31466 Electronic states and potential energy surfaces of PdH_2: Comparison with PtH_2. Balasubramanian, K.; Feng, P.Y.; Liao, M.Z. (Department of Chemistry, Arizona State University, Tempe, Arizona 85287-1604). *Journal of Chemical Physics;* **88**: No. 11, 6955-6961(1 Jun 1988).

Complete active space MCSCF (CASSCF) followed by multireference singles and doubles configuration interaction (MRSDCI) calculations are carried out on 13 electronic states of PdH_2 and 9 electronic states of PdH^+. The bending potential energy surfaces of $^1A_1$ and $^3A_1$ electronic states were obtained. The $^1A_1$ surface contains two bent minima (θ/sub e/ = 30° and θ/sub e/ = 62°) and a higher linear minimum separated by a saddle point. The $^3A_1$ surface is relatively flat in the region of the saddle point. The Pd($^1S_0$) atom forms a weak complex with H_2 but inserts spontaneously into H_2 while the Pd($^3D_3$) atom has to surmount a large barrier for insertion into H_2. The spin—orbit effects for the electronic states of PdH_2 are estimated through relativistic configuration interaction calculations of PdH^+ whose d Mulliken population is close to that of the d population of PdH_2. The ground state of PdH_2 is found to be a weakly bound bent $^1A_1$ state with θ/sub e/ = 30° and r/sub e/ (Pd—H) = 1.67 A. The electronic state and potential energy surfaces of PdH_2 are compared with PtH_2. The Pt—H bond is found to be stronger than the Pd—H bond mainly due to relativistic effects. The Pd—H bonds are more ionic than the Pt—H bonds.

31467 **Observation of an odd/even delta-J propensity in the collisional excitation of CO_2 by hot deuterium atoms.** Hershberger, J.F.; Hewitt, S.A.; Flynn, G.W.; Weston R.E. Jr. (Department of Chemistry and Columbia Radiation Laboratory, Columbia University, New York, New York 10027). *Journal of Chemical Physics;* **88**: No. 11, 7243-7245(1 Jun 1988).

We report here the first experimental observation of such oscillations in the ro-vibrational excitation of CO_2 (01^10) by hot atoms. (AIP)

31468 **X-ray transitions in highly charged neonlike ions.** Beiersdorfer, P.; von Goeler, S.; Bitter, M.; Hinnov, E.; Bell, R.; Bernabei, S.; Felt, J.; Hill, K.W.; Hulse, R.; Stevens, J.; and others. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 11, 4153-4162(1 Jun 1988).

Wavelength measurements of n = 3 to n = 2 transitions in neonlike Xe^{44+}, La^{47+}, Nd^{50+}, and Eu^{53+} have been made using a high-resolution Bragg-crystal spectrometer on the Princeton Large Torus tokamak. The measurements cover the wavelength regions 2.00—3.00 A and include the electric dipole and the electric and magnetic quadrupole transitions. The measured wavelengths are compared to energy levels obtained from a multiconfigurational Dirac-Fock calculation. Systematic differences between the experimental and theoretical values are found, which vary smoothly with atomic number. The magnitude of the differences depends on the particular type of transition and ranges from -2.8 eV to +2.2 eV. Inclusion of electron correlation corrections due to ground-state correlations and (super-) Coster-Kronig-type fluctuations in the theoretical energies is shown to reduce the differences for some but not all types of transitions.

31469 **Measurement of isotope shifts of two-photon transitions in beryllium.** Wen, J.; Travis, J.C.; Lucatorto, T.B.; Johnson, B.C.; Clark, C.W. (National Measurement Laboratory, National Bureau of Standards, Gaithersburg, Maryland 20899). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 11, 4207-4212(1 Jun 1988).

We have measured ^{10}Be:^{9}Be isotope shifts in the ^{1}S and ^{1}D Rydberg series by resonance-ionization mass spectrometry. Pronounced interference of exchange and correlation contributions to the isotope shift is observed in the ^{1}D series, reflecting strong interaction of 2snd and 2pnp channels. The finite-mass correction to the ionization energy of ^{10}Be is inferred to be 270 +- 40 MHz.

31470 **Hyperfine structure of Sc II: Experiment and theory.** Young, L.; Childs, W.J.; Dinneen, T.; Kurtz, C.; Berry, H.G.; Engstroem, L.; Cheng, K.T. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 11, 4213-4219(1 Jun 1988).

Collinear laser—ion-beam spectroscopy has been used to measure hyperfine structure (hfs) in three levels of the $3d^2$ and six levels of the 3d4p configuration of Sc II. The results combine with earlier measurements of hfs within these configurations to give a fairly complete picture of hfs in these configurations. The combined results are compared with multiconfiguration Dirac-Fock (MCDF) ab initio calculations. Good agreement is obtained for the magnetic dipole hfs constants of the singlet states in both the $3d^2$ and 3d4p configurations, but the MCDF predictions for the triplet states are not even qualitatively correct. The poor agreement for the triplet states appears to be due to the neglect of core polarization in the present MCDF approach.

31471 **Resonant enhanced multiphoton ionization studies in atomic oxygen.** Dixit, S.N.; Levin, D.A.; McKoy, B.V. (Lawrence Livermore National Laboratory, University of California, P.O. Box 808, Livermore, California 94550). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 11, 4220-4228(1 Jun 1988).

In this paper we analyze two-photon-resonant three-photon ionization of atomic oxygen via the $2p^3(^4S^o)np\,^3P_o$,1,2, and the $2p^3(^4S^o)nf\,^3F_{2,3,4}$ states. The various atomic parameters required for calculating the resonant enhanced multiphoton ionization (REMPI) probabilities are obtained using quantum-defect theory. The infinite sums over nonresonant states are truncated at a finite number of terms. Our calculated two-photon excitation cross sections agree well with the results of other recent calculations and of experimental measurements. The photoionization cross section is calculated for various electron kinetic energies. The REMPI dynamics is analyzed by solving the density-matrix equations. This framework consistently takes into account the effects of saturation and ac Stark shifts. REMPI probability is seen to be quite sensitive to the initial detuning, the intensity, and the particular resonant state accessed. The photoionization cross sections also imply that due to the rapid falloff of the cross section, two-color REMPI schemes with a lower-frequency ionizing photon would increase the effective REMPI probability.

31472 **Measurements of the hydrogen 2s-2p coherence using the quantum-beat technique.** DeSerio, R.; Gonzalez-Lepera, C.; Gibbons, J.P.; Burgdoerfer, J.; Sellin, I.A. (Department of Physics, University of Tennessee, Knoxville, Tennessee 37996). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 11, 4111-4117(1 Jun 1988).

We have measured Lyman-α quantum beats from coherently excited hydrogen atoms produced in 85—235-keV proton collisions with a thin helium jet target. Intensity measurements of the radiation emitted at 90° to the beam direction as a function of distance downstream from the target in electric fields both parallel and antiparallel to the beam axis allow extraction of the coherence between the s and p states by Eck's method [Phys. Rev. Lett. 31, 270 (1973)]. Because the jet target allows the collisions to occur in the applied field, we have eliminated the problems associated with field inhomogeneities when gas target cells are used. A strong-intensity peak emitted by excited helium in the target allows a determination of the starting point of the evolution in the field as well as a determination of the effects of experimental averaging. We present the s-p coherence parameters as a function of the projectile energy and compare them with recent theoretical calculations.

31473 **Angular distribution of fast protons from singly and doubly ionizing collisions with He.** Kamber, E.Y.; Cocke, C.L.; Cheng, S.; Varghese, S.L. (J. R. Macdonald Laboratory Physics Department, Kansas State University, Manhattan, Kansas 66506). *Physical Review Letters;* **60**: No. 20, 2026-2029(16 May 1988).

Angular distributions of 3—9-MeV protons scattered in singly and doubly ionizing collisions with He have been measured. A sharp shoulder is seen at 0.55 mrad, a feature attributed to binary encounters between the projectile protons and quasifree target electrons. The ratio of double to single ionization of He is found to be nearly independent of scattering angle between 0.25 and 0.55 mrad and to have a value near 2% substantially lower than the ratio found in photoionization producing fast ejected electrons with the same energies.

31474 **Multiply stripped ion generation in the metal vapor vacuum arc.** Brown, I.G.; Feinberg, B.; Galvin, J.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **63**: No. 10, 4889-4898(15 May 1988).

We consider the charge state distribution of ions produced in the metal vapor vacuum arc plasma discharge. A new kind of high current metal ion source in which the ion beam is extracted from a metal vapor vacuum arc plasma has been used to obtain the spectra of multiply charged ions produced within the cathode spots. The cathode materials used and the species reported on here are: C, Mg, Al, Si, Ti, Cr, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, Rh, Pd, Ag, In, Sn, Gd, Ho, Ta, W, Pt, Au, Pb, Th, and U; the arc current was 200 A for all measurements. Charge state spectra were measured using a time-of-flight method. In this paper we report on the measured charge state distributions and arc voltages and compare the distributions with the predictions of a theory in which ionization occurs in the cathode spots via stepwise ionization by electron impact.

31475 Photoemission from Xe in the vicinity of the 4d Cooper minimum. Lindle, D.W.; Ferrett, T.A.; Heimann, P.A.; Shirley, D.A. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] A: General Physics;* **37**: No. 10, 3808-3812(15 May 1988). Contract AC03-76SF00098.

Partial photoionization cross sections and angular-distribution asymmetry parameters have been determined for the Xe 4d and "4p" subshells in the photon-energy region of the 4d Cooper minimum (160 eV to 270 eV, to 520 eV for the 4d asymmetry parameter). The Cooper minimum is observed as a distinct cross-section minimum in the 4d photoionization channel. The 4d angular-distribution results are in excellent agreement with Dirac-Fock and relativistic random-phase-approximation calculations and with previous measurements. Effects of interchannel coupling are evident in the "4p" results. Both the partial cross section and the angular distribution for the "4p" photoelectron peak track the 4d cross section and angular distribution as functions of photon energy. A similar result is observed for the summed intensity and the angular distribution of the $4d^{-1}5p^{-1}np$ satellites of the 4d main line, which is probably due to the effects of electron correlation between the 4d and the satellite photoionization channels.

31476 Complex Kohn variational method: Application to low-energy electron-molecule collisions. Schneider, B.I.; Rescigno, T.N. (Theoretical Division T-12, Los Alamos National Laboratory, MS J-569, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **37**: No. 10, 3749-3754(15 May 1988).

An algebraic variational method, based on application of the Kohn principle to the T matrix, is formulated for multichannel scattering problems and applied to the case of low-energy electron-molecule collisions. The method requires only Hamiltonian matrix elements and is anomaly-free. The present formulation is noteworthy in that it requires no bound-free nor free-free exchange matrix elements. The new technique is illustrated by application to $e^- + H_2$ scattering in both the static-exchange and the two-state approximations. The method is found to be both efficient and accurate.

31477 Rate coefficients for populating excited levels of He-like ions by inner-shell ionization of Li-like ions. Sampson, D.H.; Zhang, H.L. (Department of Astronomy, The Pennsylvania State University, University Park, Pennsylvania 16802). *Physical Review [Section] A: General Physics;* **37**: No. 10, 3765-3776(15 May 1988).

Simple expressions that include intermediate coupling mixing effects are given for the cross sections and rate coefficients for populating the singly excited levels of He-like ions through the process of inner-shell ionization of Li-like ions by electron impact. Illustrative numerical values for the rate coefficients for inner-shell ionization of several Li-like ions are given and compared with the rate coefficients for populating the same upper levels by the alternative mechanism of electron impact excitation from the ground level of the He-like ions. For the temperatures at which the abundance of the He-like stage of ionization is a maximum, the inner-shell ionization rate coefficients increase relative to the excitation rate coefficients as the nuclear charge number Z increases. It appears that for all but very low Z, inner-shell ionization is an important mechanism for populating at least some of the excited levels of He-like ions. It is especially important for populating the $(1s_1 2s_1 2)_1$ or $1s2s\ ^3S_1$ level.

31478 Optimized trial wave functions for quantum Monte Carlo calculations. Umrigar, C.J.; Wilson, K.G.; Wilkins, J.W. (Theory Center and Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York 14853). *Physical Review Letters;* **60**: No. 17, 1719-1722(25 Apr 1988).

We present a procedure for obtaining optimized trial wave functions for use in quantum Monte Carlo calculations that have both smaller statistical errors and improved expectation values, compared to commonly used functions. Results are presented for several two-electron atoms and ions (including some excited states) and for the Be atom.

31479 Measurement of electron-impact—excitation cross sections for very highly charged ions. Marrs, R.E.; Levine, M.A.; Knapp, D.A.; Henderson, J.R. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physical Review Letters;* **60**: No. 17, 1715-1718(25 Apr 1988). Contract W-7405-ENG-48.

We report the first measurements of electron-impact—excitation cross sections for very highly charged ions (Ba^{46+}), and introduce a powerful new technique for studying these ions. Approximately 2×10^4 Ba^{46+} ionscm were trapped inside the space charge of an ≃120-mA electron beam and their x-ray emission spectra observed with Si(Li) and Bragg-crystal—diffraction spectrometers. Cross sections for several N = 3 levels excited from the neonlike Ba^{46+} ground state were measured relative to radiative recombination on the same ions.

31480 (LA-tr—88-7) Theory of cascade bunching of electron flow in the presence of current harmonics and velocity to a non-parametric approximation. Katsman, I.A.; Movnin, S.M. Translated from *Elektronnoe Priborostroeni ;* No. 5, 19-25(1968). Contract W-7405-ENG-36. 8p.

By oscillation equations of electron flow at variable velocity, it was shown that it is possible to calculate the bunhing process, in the initial section or phase, in the presence of harmonics of current and velocity. An expression is obtained for all multiple harmonics of current bunching, derived by assuming natural oscillation constant frequencies of electron flow along the section of bunching.

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31481 (AD-A—189277/7/XAB) Theory and simulation of the Rayleigh-Taylor instability in the large Larmor-radius limit. Memorandum report. Huba, J.D.; Lyon, J.G.; Hassam, A.B. (Naval Research Lab., Washington, DC (USA)). 29 Dec 1987. 21p. (NRL-MR—6070). NTIS, PC A03/MF A01.

The theory and first nonlinear simulations of the Rayleigh-Taylor instability in the large ion Larmor radius limit (i.e., rho/sub i/L >> 1) are presented. It is shown that in the large Larmor-radius limit, the Rayleigh-Taylor instability evolves much faster and in a dramatically different manner than in the small Larmor-radius limit.

31482 (IC—87/299) Behaviour of the vortex state in magnetic superconductors. Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702699/JAW.

The distribution of the magnetic field inside a ferromagnetic superconductor (FS) has been developed. The behaviour of the surface pinning in different geometries of FS system has been considered. We have shown that, for FS systems, the superheating field is of the order of thermodynamic critical field for magnetic superconductors H*/sub s/. (author). 6 refs, 2 tabs.

31483 (LA—11161-MS) SOLA-DM: A numerical solution algorithm for transient three-dimensional flows. Wilson, T.L.; Nichols, B.D.; Hirt, C.W.; Stein, L.R. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 88p.

SOLA-DM is a three-dimensional time-explicit, finite-difference, Eulerian, fluid-dynamics computer code for solving the time-dependent incompressible Navier-Stokes equations. The solution algorithm (SOLA) evolved from the marker-and-cell (MAC) method, and the code is highly vectorized for efficient performance on a Cray computer. The computational domain is discretized by a mesh of parallelepiped cells in either cartesian or cylindrical geometry. The primary hydrodynamic variables for approximating the solution of the momentum equations are cell-face-centered velocity components and cell-centered pressures. Spatial accuracy is selected by the user to be first or second order; the time differencing is first-order accurate. The incompressibility condition results in an elliptic equation for pressure that is solved by a conjugate gradient method. Boundary conditions of five general types may be chosen: free-slip,

no-slip, continuative, periodic, and specified pressure. In addition, internal mesh specifications to model obstacles and walls are provided. SOLA-DM also solves the equations for discrete particle dynamics, permitting the transport of marker particles or other solid particles through the fluid to be modeled. 7 refs., 7 figs.

31484 **(LA-UR—88-508) A semigroup for Lagrangian 1D isentropic flow.** Pimbley, G.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 14p. (CONF-880123—1). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88006464/JAW.

From Conference on transport theory, invariant imbedding and integral equations; Santa Fe, NM, USA (20 Jan 1988).

This paper discusses a system of Lagrangian equations used to describe 1D isentropic flow. This paper covers the approximate differential equations, the Banach space re-metrization and semigroup generation. 10 refs.

31485 **(LA-UR—88-1025) Optical diagnostics for a high power, rf-inductively coupled plasma.** Nogar, N.S.;Keaton, G.L.;Anderson, J.E.;Trkula, M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880408—7).

From Spring meeting of the Materials Research Society; Reno, NV, USA (4 Apr 1988).

Emission spectroscopy and laser-induced fluorescence have been used to monitor the field and tail-flame regions of a Hull-design inductively coupled plasma. This plasma is used for a variety of syntheses including SiC, TiC, BN, AlN and diamond. Temporally- and spatially-resolved spectra of both pure Ar and Ar/gas mixtures have been studied as a function of RF power, pressure and flow rate. Preliminary data suggest that the system is far from local thermodynamic equilibrium.

31486 **(LBL—24370) The influence of surfactants on the flow of long bubbles through cylindrical capillaries.** Ginley, G.M.; Radke, C.J. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 14p. (CONF-880659—1).

From Symposium on advances in oil field chemistry; Toronto, Canada (5 Jun 1988).

Foam is a promising fluid for increasing mobility control in underground enhanced oil recovery. An understanding of the fundamentals of foam flow in porous media may be gained by studying the flow of surfactant-stabilized bubble trains in capillary tubes. Thus, by scaling arguments similar to those used for non-Newtonian polymer solutions (3), it appears possible to predict foam-flow behavior in porous media using measurements of a theory for bubble flow in tubes. This work considers the behavior of a single gas bubble in a capillary with the continuous liquid phase containing surfactant whose concentration is near or above the critical micelle concentration. We extend Bretherton's analysis for a clean gas bubble to include the effects of a kinetically hundered, soluble surfactant in the liquid phase on the shape of the bubble, and on the resulting pressure drop across the bubble. 6 refs., 3 figs.

31487 **(SAND—88-0504/1) Navier-Stokes code NS3D for blunt bodies: Part 1, Analysis, results, and verification.** Blottner, F.G.; Larson, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 78p.

A Navier-Stokes code for calculating the laminar or turbulent flow over blunt bodies in supersonic flow has been developed from a transonic flow code. The unsteady thin-layer form of the governing equations for a perfect gas are solved with a linearized block Alternating-Direction Implicit finite-difference solution procedure. Sensitivity of the solutions to code input parameters is investigated. Predictions obtained from the code are presented and compared to numerical and experimental results. This study indicates that very accurate surface pressures and reasonably accurate heat transfer predictions are obtained from the code. 20 refs., 34 figs., 6 tabs.

31488 **(TRITA-PFU—86-13) Reports from the department of plasma physics and fusion research. Index and abstracts 1986.** (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Mar 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753035/JAW.

The report lists titles and summaries of 13 reports in the TRITA-PFU-Series, titles of 4 articles published in journals, and titles of 4 papers contributed to conferences. The publications were published by the Royal Institute of Technology, Stockholm, Sweden. (G.B.).

31489 **(UCID—20297-87-4) LLNL Granular Solids Flow Project: Quarterly report, October-December 1987.** Walton, O.R. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 10p.

This project is directed toward obtaining a fundamental understanding of the flow behavior of granular solids and multi-phase solids-containing systems. Here we report progress in two new areas of study, quasi-static deformations and suspension rheology. Discrete particle computer models have the potential for becoming very useful tools for understanding such problems. We have begun a reexamination of our computer models to see how they can most effectively be applied to the many granular solids flow problems that involve quasi-static deformations. We have carefully reviewed our models of tagential friction between elastic spheres in contact, and have developed improved algorithms. We have also initiated development of more complex models that include adhesive surface forces and non-constant coefficients of friction. These new algorithms will be added to the 3DSHEAR model in the near future. We are examining various approaches to determine the rheologic properties of suspensions. As part of this effort we are developing a general numerical method to calculate the hydrodynamic interactions for arbitrary assemblies of spheres in suspension. The first results with this method involve assemblies of a small number of equal size spheres with periodic boundaries. The method utilizes effective induced forces on the sphere surfaces and approximately accounts for the effects of all spheres in the system (including their periodic images). The numerical results agree with analytic expansions valid when the solid particles are far apart, and with known results for periodic arrays containing one or two particles per unit cell. Further extensions of this work are planned.

31490 **(UCID—21316-Rev.1) Numerical simulation of turbulent premixed combustion and decay of turbulent swirling flow.** Cloutman, L.D. (Lawrence Livermore National Lab., CA (USA)). 27 Jan 1988. Contract W-7405-ENG-48. 16p.

We present the results of the numerical simulation of three experiments with the CONCHAS-SPRAY and KIVA hydrodynamics programs. Both codes are shown to give acceptable accuracy, although it would be desirable to improve the turbulence models and turbulent combustion rate model. 15 refs., 8 figs.

31491 **Interaction between a compliant material and an unstable boundary layer flow.** Hall, M.S. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Computational Physics;* **76**: No. 1, 33-47(May 1988).

The response of a compliant coating to pressure fluctuations due to an unsteady boundary layer flow and the effect of the response on the stability of the flow field are examined. A pseudo-spectral solution of the Navier—Stokes equations is coupled to a finite element calculation of the behavior of the compliant material. In particular, the effect of material response on the growth rate of a Tollmien—Schlichting type instability in an unstable boundary layer is examined. Results are presented for three materials; a soft polyvinylchloride (PVC), a stiffer PVC, and a two-layer material consisting of a thick layer of soft PVC covered by a thin layer of neoprene. copyright 1988 Academic Press, Inc.

31492 Simulation of Rayleigh—Taylor flows using vortex blobs. Kerr, R.M. (L-321, Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California 94550). *Journal of Computational Physics;* **76**: No. 1, 48-84(May 1988).

An inviscid boundary-integral method is modified in order to study the single-scale Rayleigh—Taylor instability for arbitrary Atwood number. The primary modification uses vortex blobs to smooth the Green's function and suppress a finite time singularity in the curvature. Additional modifications to earlier codes such as using second-order central differences along the interface to accommodate spikes in the vorticity and spreading the nodes evenly along the interface to suppress clustering of nodes are designed to maintain resolution and accuracy. To achieve second-order accuracy in time when the nodes are spread, an extra predictor step is needed that shifts the nodes before the variables are advanced. The method successfully follows the development of a single mode to states with asymptotic velocities for the bubble and spike that depend on the Atwood number and are independent of the blob size. Incipient droplet formation is observed. copyright 1988 Academic Press, Inc.

6450 High Energy Physics

31493 (SLAC-PUB—4589) Thoughts on software and computing. Kunz, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515. 9p. (CONF-871071—2).

From 8. Vanderbilt high energy physics conference; Nashville, TN, USA (8 Oct 1987).

This talk has three distinct parts. The first two parts are on vector and parallel processing and their success, or lack thereof for HEP. The third part is an analysis on the software situation in HEP. These topics have been chosen because of the frequency with which they are discussed in the hallways of our laboratories and institutions. This review looks at the field from a particular point of view: that of an experimental physicist working with a large detector at a collider and, in addition, only considers the offline processing aspects of the field. 7 refs., 7 figs.

31494 Proceedings of the Salt Lake City meeting: Third regular meeting (New Series) of the Division of Particles and Fields of the American Physical Society. DeTar, C.; Ball, J. (eds.). Singapore; World Scientific Publishing Co. Pte. Ltd. (1987). 679p. (CONF-870121—). World Scientific Publishing Co., 687 Hartwell Street, Teaneck, NJ 07666. Contract FG02-87ER40308.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

This book contains papers on topics in high energy physics and particle physics. The conference papers are grouped into the following topics: Electroweak Interactions; Beyond the Standard Model: Phenomenology and Experiments; Superunification Theory; Field Theory and Theory of the Strong Interactions; Hadron Physics; and Detectors and Accelerators. Separate abstracts were prepared for 46 papers in these proceedings.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 30969, 31539, 31572

31495 (BNL—34518-Ed.4) AGS experiments: 1985, 1986, 1987. Depken, J.C. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 119p.

This report contains: Experimental areas layout, table of beam parameters and fluxes, experiment schedule "as run," experiment long range schedule, a listing of experiments by number, two-page summaries of each experiment, also ordered by number, and publications of AGS experiments, 1982-1987.

31496 (BNL—41003) Comparison of exclusive reactions at large momentum transfer. Carroll, A.S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 12p. (CONF-8710274—4).

From 2. international conference on elastic and diffractive scattering; New York, NY, USA (15 Oct 1987).

This paper discusses exclusive reactions at large momentum transfer: namely two-body reactions where all of the final state particles have been kinematically identified. In particular $pp \rightarrow px$, $\pi^+ p \rightarrow \pi^+ x$, $\pi^+ p \rightarrow px^+$, $\pi^+ p \rightarrow k^+ x$ and $pp \rightarrow pp$ reactions are discussed. 11 refs., 6 figs.

31497 (CEA-N—2549) Study of direct photon production in proton-antiproton interactions at a center-of-mass of 630 GeV with UA2 detector. Lancon, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Feb 1988. 288p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88753475/JAW.

A study of direct photon production in proton antiproton collisions performed at CERN using the UA2 detector is presented. Direct photon cross sections have been measured for two pseudo-rapidity values (0 and 1.4). The transverse momentum range extends from 12 to 50 GeVc. Estimation of the signalnoise ratio is explained and sources of systematic uncertainties are summarized. The π^0 production cross section is also determined for a pseudo-rapidity of 1.4. Six events containing two photons in the final state are observed. The photonjet production ratio is determined and found to be in agreement with first order quantum chromodynamic based calculations. The photonπ^0 production ratio is increasing with transverse momentum and is compared with a measurement performed at the ISR at a center of mass energy ten times smaller. Direct photon cross sections are well described by a second order quantum chromodynamic calculation.

31498 (CERN-EP—86-181) Missing-energy results from the UA1 experiment. Batley, R. (Queen Mary Coll., London (UK)). 12 Nov 1986. 27p. (CONF-8606286—5).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

Results from an analysis of events containing large missing transverse energy from the UA1 experiment at the CERN SPS p anti p Collider are presented. A signal for tau production from the decay $W \rightarrow$ tau nu is observed. The cross-section Σ dot B ($W \rightarrow$ tau nu) is found to be consistent with the corresponding cross-sections for $W \rightarrow$ e nu and $W \rightarrow \mu$ nu decays, providing a direct test at high energies ($Q^2 =$ m/sub $w/^2$) of the universality of W boson coupling strengths to e, μ, and tau leptons. The rate and properties of the large missing E/sub T/ events are consistent with expectations from W^+, Z^0, and heavy-flavor production. Limits are set on the number of additional species of light neutrinos allowed in the Standard Model (ΔN nu $\leqq 7$ at 90% CL), on the mass of a new sequential chargd heavy lepton (m/sub L/ > 41 GeVc^2 at 90% CL), and on the masses of supersymmetric particles (m/sub q-tilde/ > 70 GeVc^2, m/sub g-tilde/ > 60 GeVc^2 at 90% CL). 25 refs., 19 figs.

31499 (CERN-EP—86-198) Hard scattering of real photons in NA14. Katsoufis, E.C. (European Organization for Nuclear Research, Geneva (Switzerland); Ethnikon Metsovion Polytechneion, Athens (Greece)). 25 Nov 1986. 19p. (CONF-8509280—5).

From 2. Hellenic school on elementary particle physics; Corfu, Greece (1 Sep 1985).

A review is given of the results obtained up to now in hard scattering of real tagged photons of energies in the range 50 to 150 GeV, with the NA14 spectrometer at CERN. In particular, after a short description of the experiment, the evidence found for the deep Compton process of QED and QCD is shown and the precise quantitative tests of perturbative QCD, made with the observed high p/sub T/ prompt γ, π^0 and charged hadron inclusive production, are presented. 23 refs., 11 figs.

31500 (CERN-EP—87-40) Search for neutral Higgs at LEP 200. Boucrot, J.; Hilgart, J.; Loucatos, S.; Mermikides, M.; Ritz, S.; Wu, Sau Lan; Zobernig, G. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Wisconsin Univ., Madison (USA). Dept. of Physics; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Stockholm Univ. (Sweden); Lund Univ. (Sweden); Technion-Israel Inst. of Tech., Haifa). 23 Feb 1987. 91p. (CONF-8609223—7).

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

We are searching for the Higgs boson from $e^+e^- \rightarrow H^0Z^0$ at E/sub cm/ = 200 GeV using a realistic detector simulation, including a track finding algorithm and pattern recognition, and detailed background studies. Sophisticated analysis methods have been used to demonstrate what levels of signals and what Higgs masses we can see at LEP II with E/sub cm/ = 200 GeV. 32 refs., 28 figs., 5 tabs.

31501 (CERN-EP—87-49) New leptons and quarks. Igo-Kemenes, P.;Kuehn, J.H.;Barlow, R.;Coignet, G.;De Angelis, A.;Delikaris, D.;Gasparini, U.;Gopal, G.;Guesken, S.;Jadach, S. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); Manchester Univ. (UK). Dept. of Physics; Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules; Padua Univ. (Italy). Ist. di Fisica; College de France, 75 - Paris. Lab. de Physique Nucleaire). 2 Mar 1987. 62p. (CONF-8609223—11). NTIS (US Sales Only), PC A04/MF A01;1. Order Number DE88900436/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

The Standard Model has been tremendously successful in the past decade, correctly describing all experimental facts down to distances of Script O (10^{-16} cm). Many fundamental problems however remain unsolved by the theory, making it mandatory to explore possible extensions into which the model can be embedded in a natural way. In the fermionic sector, on which this study focusses, such extensions are provided by introducing further replicas of the known three generations or by expanding the generation multiplets themselves, as suggested by grand-unification theories. These two scenarios where the known three families have been complemented by the addition of a fourth family, and each family has been enlarged according to E(6) grand-unification. The information on the possible existence of a fourth generation is scarce. Small deviations from the unitarity of the 3-generation Kobayashi-Maskawa matrix could eventually be interpreted as a consequence of missing t' and b' matrix elements. The mass of a charged fourth-generation lepton has been constrained to m(L) $\geqq$ 41 GeV while the lower limit for the mass of a new quark is presently 23 GeV from PETRA experiments. This situation is bound to change in the coming years due to data from existing hadron colliders, from SLC and from the first phase of LEP. 51 refs., 55 figs., 4 tabs.

31502 (CONF-8711128—5) B-physics at D0. Hedin, D.;Kramer, T.;Roberts, K. (Northern Illinois Univ., Dekalb (USA); California Univ., Riverside (USA)). 1987. Contract AC02-87ER40368. 6p. NTIS, PC A; 02; GPO Dep. Order Number DE88007205/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

This report presents a study of the capabilities of the D0 detector to do B-related physics by utilizing the presence of a muon both as a trigger and as a tag. The almost complete muon coverage plus the fine calorimeter segmentation will allow D0 to expand upon the B-physics which have been done at UA1 with muons. This report will briefly discuss the physics topics and then will present rate calculations from different muon sources along with studies on how to separate them based upon their topologies and kinematics. 5 refs., 7 figs., 2 tabs.

31503 (CONF-8711128—6) Backgrounds to the detection of two-body hadronic B decays. Kaplan, D.M.;Peng, Jen-Chieh;Abrams, G.S.;Stockdale, I.E. (Northern Illinois Univ., Dekalb (USA); Los Alamos National Lab., NM (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Illinois Univ., Urbana (USA)). 8 Jan 1988. Contract AC02-87ER40368. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007204/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

We consider backgrounds to the detection of the two-body hadronic decay modes of neutral B mesons and baryons. The largest background is due to the correlated production of pairs of high-p/sub T/ hadrons in the target, but this can be adequately rejected provided the experimental apparatus has sufficient resolution in mass and decay vertex. Another possible source of background arises from the production and decay of charmed and strange particles. Since these particles can travel considerable distances before decaying, they can give rise to backgrounds which may not be rejectable by means of vertex cut. We have simulated several backgrounds from charm, and we find them to be small compared to the expected level of signal. 8 refs., 1 fig., 2 tabs.

31504 (FNAL/C—88/22) QCD: Photo/hadroproduction of heavy flavors;Fermilab E691, E769 and beyond. Appel, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1988. Contract AC02-76CH03000. 13p. (CONF-8710276—2). NTIS, PC A; 03; GPO Dep. Order Number DE88007284/JAW.

From Advanced research workshop on QCD hard hadronic processes; St. Croix, Virgin Islands, U.S. (8 Oct 1987).

A series of heavy flavor experiments is being performed at the Fermilab Tagged Photon Laboratory. These experiments make use of accurate charged particle tracking, including precise vertex determinations, in an open geometry forward spectrometer. The global transverse energy trigger has high acceptance for all heavy flavor decay modes and allows a wide variety of questions to be addressed. Some of the results for the completed charm photoproduction experiment, especially production dynamics and relative branching ratios, have been selected for presentation. Their selection is due to their relevance to questions fundamental to QCD, the topic of this workshop. Other results (e.g., on charm particles lifetimes, mixing, Cabibbo single and doubly suppressed decays, etc.) have appeared already or are about to appear. The current experiment, charm hadroproduction, is also described and its status presented. Finally, plans for future efforts, including beauty hadroproduction, are summarized. 5 refs., 13 figs., 4 tabs.

31505 (FRNC-TH—3176) Direct production research of Q^0 and glueballs in the hadronic collision π-N at 300 GeVc. Neaume, C. (Paris-11 Univ., 91 - Orsay (France)). Jan 1987. 128p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88753070/JAW.

The objective of this experience was double: put in clearness the production of rho^0 in the interaction π^-N at 300 GeVc by a direct production mechanism and research the glueballs producted by this same mechanism. The results indicate that the direct production of rho^0 is in agreement with the model of Benayoun and all but we cannot observe signals of θ(1640) and iota(1440) with the intensity predicted by this model. This can be explicate if these two particles are not glueballs or, if they are glueballs, their structure constants are very different of these of qantiq ordinary mesons.

31506 (IFVE-ONF—87-29) Investigation of elastic πip, K^+p and pp scattering at 250 GeVc. Adamus, M.; Agababyan, N.M.; Azhinenko, I.V. and others. (Warsaw Univ. (Poland); Erevanskij Fizicheskij Inst. (USSR); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 8p. (In Russian). (CERN-NA—22). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702749/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Results are presented on experimental study of π^+p-, K^+p- and pp elastic scattering at 250 GeVc obtained with the European

Hybrid Spectrometer at the highest energy so far reached for positive meson beams. Differential dσ/dt and total elastic cross sections are compared with data obtained at other energies. Starting from Serpukhov energies, the π^+p elastic cross section stays practically constant with energy, while the K^+p cross section increses. 3 refs.; 3 figs.; 3 tabs.

31507 **(INFN/AE—86-12) Measurements of D-meson lifetimes in NA27.** Caso, C. (Istituto Nazionale di Fisica Nucleare, Pavia (Italy)). 28 Nov 1986. 17p. (CONF-8609397—1).

From EHS symposium; Balatonaliga, Hungary (8 Sep 1986). No abstract entered into RPS yet.

31508 **(LA-UR—88-892) Present and future neutrino physics research at the Los Alamos Meson Physics Facility.** Sanders, G.H. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 19p. (CONF-880369—1).

From International symposium on neutrino mass and related topics; Tokyo, Japan (16 Mar 1988).

The Los Alamos Meson Physics Facility is currently the site of two neutrino experiments. A measurement of elastic scattering of electron-neutrinos on electrons is providing confirmation of the destructive interference between the weak neutral and charged currents predicted in the standard electroweak theory. A search for the appearance of {bar}ν/sub e/ is being carried out at the LAMPF beam stop, as well. The status of this experiment is described. A major new initiative is being undertaken to measure neutrino-electron scattering in a large water Cerenkov detector. This meaurement will be precise enough to provide, in combination with the meaurements to be performed at the new generation of high-energy electron-positron colliers, the first experimental study of the standard electrowak theory at the level of one-loop radiative corrections. The detector will also be a vehicle for neutrino-oscillation searches, measurement of neutrinos from supernovae, and other fundamental physics. The apparatus will consist of a neutrino production target and shield surrounded by a water Cerenkov detector. The fiducial volume of water will be approximately 7000 tons, viewed by approximately 13000 20 cm diameter photomultiplier tubes. 11 refs., 6 figs.

31509 **(LAL—87-34) First observation of the eta/sub c/->rho^{0}rho^0 decay.** Bisello, D.; Busetto, G.; Castro, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Sep 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753073/JAW.

The decay JPSI->γeta/sub c/->$\gamma\pi^+\pi^-\pi^+\pi^-$ has been studied from the 8.6x10^6 JPSI produced in the DM2 apparatus at DCI. A clear signal of (137+-23) events is observed in the eta/sub c/ mass range. A partial wave analysis shows that the decay proceeds mainly through rho^{0}rho^0 dynamics with BR (JPSI->γeta/sub c/) x BR(eta/sub c/->rho^{0}rho^0) = (1.10+-0.10+-0.20) x 10^{-4}. The observation of the eta/sub c/->rho^{0}rho^0 decay gives the first high statistics evidence of the pseudoscalar nature of the eta/sub c/.

31510 **(LAL—87-42) Pseudoscalar states in J/PSI->γVV decays. Results from DM2.** Stanco, L.; Ajaltouni, Z.; Dekmouche, A.; Falvard, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Aug 1987. 7p. (CONF-8705198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753074/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

We present new results from the DM2 experiment on the eta/sub c/-state and the pseudoscalar production seen at the threshold of the vector-vector radiative decays at JPSI. The eta/sub c/ shows a vector-vector dominance in its decays and has a decay pattern which follows the SU(3)F symmetry prediction, this being in contradiction with previous measurements. New pseudoscalar states are clearly present in the invariant mass spectrum of rho^{0}rho^0. There are at least three different resonances, here named L_1, L_2, L_0 to underline a supposed common origin. These states have no direct interpretation in the usual qantiq model and they are believed to have an isoscalar nature. An interesting new upper limit on the gT's(2000(division)2500 MeVc^2) production at JPSI is given as a by-product of the rho^{0}rho^0 analysis.

31511 **(LAL—87-43) DM2 results on JPSI and eta/sub c/ decays.** Ajaltouni, Z.; Dekmouche, A.; Falvard, A. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Aug 1987. 4p. (CONF-870632—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753075/JAW.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Final results are presented on JPSI->γrho^{0}rho^0. The multichannel analysis shows a large pseudoscalar contribution which can be fitted with 3 Breit-Wigners and a small background. In this channel are observed eta/sub c/ and f_1(1285) productions. eta/sub c/->rhorho, $\omega\omega$, PHIPHI, K*antiK* are analysed in the framework of SU(3) and are consistent with nonet symmetry. At last, Vector+Pseudoscalar final states are studied. eta and eta' wave functions can be saturated by their quark content. The pseudoscalar mixing angle is measured to be-(20.0+-1.6)^0.

31512 **(LAL—87-55) Study of J/PSI(3097) decay towards final states with three or five photons.** Couchot, F. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Paris-11 Univ., 91 - Orsay (France)). Dec 1987. 183p. (In English and French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88753076/JAW.

High statistics studies of JPSI(3097) decays are a new way to look at low mass mesons. They give informations about the quark content of already known mesons and they allow the search for gluon bound states predicted by quantum chromodynamics. This work presents results obtained on 8.6 million JPSI decays with the DM2 detector at Orsay. The analysis of all neutral decays requires the understanding and optimization of the photon detector, for which a special work has been done. In the three photon state, a new measurement of the branching ratio of the JPSI into $\gamma\pi^0$ is given, and new limits on the eta/sub c/ width into two photons and on the direct decay rate into three photons are computed. In the five photon final state, the intermediate state $\gamma\pi^0\pi^0$ and γetaeta are studied. The preceding results, from the single experiment Crystal Ball are confirmed.

31513 **(LBL—24493) Bose-Einstein correlations in e^+e^- collisions.** Juricic, I. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 168p.

The MARK II detector is used to study the Bose-Einstein correlation between pairs and triplets of charged pions produced in hadronic decays of the J{psi}, the $\sqrt{s}$ = 4 to 7 GeV continuum above the J{psi}, two photon events at $\sqrt{s}$ = 29 GeV, and e/sup {plus/}e/sup {minus/} annihilation events at $\sqrt{s}$ = 29 GeV as a function of Q^2, the four-momentum transfer squared. After corrections for Coulomb effects and pion misidentification, we find a nearly full Bose-Einstein enhancement α in the J{psi} and the two photon data and about half the maximum value in the other two data sets. The radius parameter {tau}(an average over space and time) given by pion pair analyses lies within a band of +-0.10 fm around 0.73 fm and is the same, within errors, for all four data sets. Pion triplet analyses also give a consistent radius of ~ 0.54 fm. fits to two-dimensional distributions R(q/sub T/^{2}, q/sub C/^{2}) of invariant components of Q^2 = q/sub T/^{2} {plus} q/sub C/^{2} give {tau}/sub T/ ~ {tau}C ~ {tau}, where q/sub T/ is the transverse three-momentum difference calculated with respect to the net pair three-momentum, and q/sub C/ is in effect the longitudinal three-momentum difference in the pion pair rest frame. When q/sub T/ is calculated with respect to the jet axis for two-jet events in the e/sup {plus/}e/sup {minus/} annihilation data at $\sqrt{s}$ = 29 GeV, a fit to R(q/sub T/^{2}, q/sub C/^{2}) also gives {tau}/sub T/ ~ {tau}/sub C/ ~ {tau}. Noting that q/sub L/ and q_0 are not invariant, we make fits to R(/sub T//sup T/, q/sub L/^{2}) and to R(q/sub T/^{2}, q_0^2) (Kopylov formulation), and we find {tau}$_0$ ~ {tau}/sub L/ ~ {23}{tau}/sub T/ to {12}{tau}/sub T/. 44 refs., 43 figs., 15 tabs.

31514 **(LBL—24715) Inclusive πip, K^{+-}, and p, anti p production in e^+e^- annihilation at $\sqrt{s}$ = 29 GeV.** Cowan, G.D. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 156p. NTIS, PC A08/MF A01;1; GPO Dep. Order Number DE88007371/JAW.

Measurements of π^{+-}, K^{+-} and p, anti p inclusive cross sections and fractions in e^+e^- annihilation at $\sqrt{s} = 29$ GeV are presented. The momentum interval covered corresponds to $0.01 < z < 0.90$, where z = pp/sub beam/. The analysis is based on approximately 70 pb^{-1} of data collected between 1984 and 1986 with the TPC2γ detector at PEP. Charged particles are identified by a simultaneous measurement of momentum and ionization energy loss (dEdx). The recently upgraded detector's momentum resolution of $(\Delta pp)^2 = (1.5\%)^2 + (0.65\% \cdot p\ (GeVc))^2$ and a dEdx resolution of typically 3.5% allow the measurements to be extended to higher z than previously reported. 70 refs., 59 figs., 7 tabs.

31515 **(LUNFD6/NFFL—7036-1987) Bose-Einstein Interferometry in High-Energy Hadron-Hadron Collisions.** Kulka, K. (Lund Univ. (Sweden). Dept. of Physics). 10 Apr 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753013/JAW.

Bose-Einstein interference is observed at the Axial Field Spectrometer at the CERN ISR, in pp, pp and /alpha//alpha/ collisions. The existence of the correlations is established both for equally charged pions and kaons. The radial extension of the boson emitting region is determined, and is, for identical pions, found to increase with the mean charged multiplicity of the events. In pp and pp interactions, a prolate shape of the pion source is revealed, with the beam axis as symmetry axis. For /alpha//alpha/ collisions, data are consistent with a spherical emission region.

31516 **(SLAC-PUB—4593) Recent results on open and hidden charm production in e^+e^- annihilation at 29 GeV.** Wormser, G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1988. Contract AC03-76SF00515;AC03-76SF00098;AC02-76ER03064. 7p. (CONF-880331—2).

From 3. Lake Louise Winter Institute on quantum chromodynamics: theory and experiment; Lake Louise, Canada (6 Mar 1988).

Inclusive {psi} production in e^+e/sup {minus/} annihilation at 29 GeV has been measured with the Mark II detector. The {psi} cross section is found to be 1.1 {+-} 0.5 {+-} 0.4 pb. An upper limit of 0.02 σ/sub $\mu\mu$/ is obtained for other sources of {psi} production. {eta} production has also been investigated, using the $\gamma\gamma$ decay mode. The {eta} fragmentation function has been measured and found to be in good agreement with the Lund model prediction. {eta}' production has been measured for the first time in high energy e^+e/sup {minus/} annihilation. A search for D/sub s//sup {+-/} decays into {eta} π/sup {+-/} and {eta}' π/sup {+-/} has been performed and evidence has been found for both decay modes at the 3 σ level. 11 refs., 5 figs.

31517 **Charmonium production in photon-photon collisions.** Aihara, H.; Alston-Garnjost, M.; Avery, R.E.; Barbaro-Galtieri, A.; Barker, A.R.; Barnett, B.A.; Bauer, D.A.; Bay, A.; Bengtsson, H.U.; Bobbink, G.J.; and others. (Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 23, 2355-2358(6 Jun 1988).

We have searched for the two-photon production of the eta/sub c/, chi_0, and chi_2 charmonium states at the SLAC e^+e^- collider PEP in the channels $\gamma\gamma \to K/sup +- /K/sub S/^0\pi/sup$ minus-or-plus/, $\gamma\gamma \to K^+K^-\pi^+\pi^-$, $\gamma\gamma \to \pi^+\pi^-\pi^+\pi^-$, and $\gamma\gamma \to K^+K^-K^+K^-$. We identify four eta/sub c/ candidates in the $K^+K^-K^+K^-$ channel on a negligible background; the one phiphi event among them implies a 95%-confidence-level lower limit for Γ/sub $\gamma\gamma$/sub γ/(eta/sub c/) of 1.7 keV. In the other channels we find no evidence for any of the three states. We establish 95%-C.L. upper limits Γ/sub $\gamma\gamma$/sub γ/(eta/sub c/)<15.5 keV, Γ/sub $\gamma\gamma$/sub γ/(chi_0)<17.0 keV, and Γ/sub $\gamma\gamma$/sub γ/(chi_2)<4.2 keV. From all channels combined, we obtain the value Γ/sub $\gamma\gamma$/sub γ/(eta/sub c/)<6.4 +- /sup 5.0//sub 3.4/ keV.

31518 **Search for isolated leptons in low-thrust e^+e^- annihilation events at $\sqrt{s} = 50$ and 52 GeV.** Igarashi, S.; Myung, S.S.; Chiba, R.; Hanaoka, K.; Miyashita, M.; Murata, H.; Yokota, H.; Bacala, A.; Imlay, R.; Kirk, P.; and others. (Tokyo Institute of Technology, Tokyo 152). *Physical Review Letters;* **60**: No. 23, 2359-2362(6 Jun 1988).

Multihadronic e^+e^- annihilation events containing final-state leptons have been investigated with a 4.7-pb^{-1} data sample at c.m. energies of 50 and 52 GeV. The number of low-thrust events ($T \leqq 0.8$) with isolated leptons is consistent with the expectation of the standard model with five quark flavors. Limits on the production of new quarks and leptons are reported.

31519 **Von Wimmersperg replies.** von Wimmersperg, U. (Physics Department, Building 901A, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **60**: No. 23, 2443-2443(6 Jun 1988).

The importance of correlation effects in analyzing resonant electron-positron interactions is discusssed. (AIP)

31520 **Measurement of spin effects in p/sub up-arrow/ +p/sub up-arrow/ $\to$ p+p at 18.5 GeVc.** Crabb, D.G.; Gialas, I.; Krisch, A.D.; Lin, A.M.T.; Peaslee, D.C.; Phelps, R.A.; Raymond, R.S.; Roser, T.; Stewart, J.A.; Terwilliger, K.M.; and others. (Randall Laboratory of Physics, The University of Michigan, Ann Arbor, Michigan 48109). *Physical Review Letters;* **60**: No. 23, 2351-2354(6 Jun 1988).

We measured the analyzing power A and the spin-spin correlation parameter A/sub n//sub n/ in medium-P/sub perpendicular/^{2} proton-proton elastic scattering, using a polarized-proton target and the 18.5-GeVc Brookhaven Alternating-Gradient Synchrotron polarized-proton beam. We found sharp dips in both A and A/sub n//sub n/, which occur at different P/sub perpendicular/^{2} values. The unexpected sharp structure in the spin-spin force occurs near P/sub perpendicular/$^2 = 2.3$ $(GeVc)^2$ where the elastic cross section has no apparent structure.

31521 **Determination of α/sub s/ from energy-energy correlations in e^+e^- annihilation at 29 GeV.** Wood, D.R.; Petersen, A.; Abrams, G.; Adolphsen, C.E.; Akerlof, C.; Alexander, J.P.; Alvarez, M.; Amidei, D.; Baden, A.R.; Ballam, J.; and others. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720 Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 University of California, Santa Cruz, California 95064 University of Michigan, Ann Arbor, Michigan 48109). *Physical Review [Section] D: Particles and Fields;* **37**: No. 11, 3091-3102(1 Jun 1988).

We have studied the energy-energy correlation in e^+e^- annihilation into hadrons at $\sqrt{s} = 29$ GeV using the Mark II detector at the SLAC storage ring PEP. We find to $O(\alpha/sub\ s/^2)$ that α/sub s/ = 0.158 +- 0.003 +- 0.008 if hadronization is described by string fragmentation. Independent fragmentation schemes give α/sub s/ = 0.10—0.14, and give poor agreement with the data. A leading-log shower fragmentation model is found to describe the data well.

31522 **Search for new, long-lived, neutral particles.** Bernstein, R.H.; Shea, T.K.; Winstein, B.; Cousins R.D. Jr.; Greenhalgh, J.F.; Schwartz, M.; Bock, G.J.; Hedin, D.; Thomson, G.B. (Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* **37**: No. 11, 3103-3106(1 Jun 1988).

We have searched for new particles of charge zero, a mass between 1.5 and 7.5 $GeVc^2$, and lifetimes between 10^{-8} and 2×10^{-6} sec, produced by 400-GeVc protons striking a beryllium target. The experiment looked for structure in the transverse-momentum spectrum of charged particles arising from decays in the Fermilab M3 neutral beam. No new particles were found. We place upper limits on the production cross section of any such particle.

31523 **Production of the D/sub s//sup +- / by high-energy neutrons.** Shipbaugh, C.; Wiss, J.; Binkley, M.; Butler, J.; Cumalat, J.P.; Coteus, P.; DiCorato, M.; Diesburg, M.; Enagonio, J.; Filaseta, J.; and others. (University of Colorado, Boulder, Colorado 80303). *Physical Review Letters;* **60**: No. 21, 2117-2120(23 May 1988).

We have observed the production of the D/sub s//sup +- / by a high-energy neutron beam on nuclear targets. The D/sub s//sup +- / was observed in the decay mode D/sub s//sup +- / $\to$ phiπ/sup +- /, phi$\to K^+K^-$. The average of the inclusive cross sections for D/sub s/$^+$ and D/sub s/$^-$ hadroproduction is measured

to be B dσ/dchi/sub F/ = 2.85 +- 0.80 +- 0.86 μbnucleon at chi/sub F/ = 0.175 on the assumption of a linear A dependence, where Bequivalent Γ(D/sub s//sup +- /→phiπ/sup +- /)Γ(D/sub s//sup +- /→all). Γ(D/sub s//sup +- /→all).

31524 Nuclear-target effects in J/psi production in 125-GeV/c antiproton and πp interactions. Katsanevas, S.; Kourkoumelis, C.; Markou, A.; Resvanis, L.K.; Tzamarias, S.; Voulgaris, G.; Binkley, M.; Cox, B.; Enagonio, J.; Hojvat, C.; and others. (University of Athens, Athens, Greece). *Physical Review Letters;* 60: No. 21, 2121-2124(23 May 1988).

The production of the J/psi resonance in 125-GeV/c p-bar and π^- interactions with Be, Cu, and W targets has been measured. The cross section per nucleon for J/psi production is suppressed in W interactions relative to the lighter targets, especially at large values of Feynman x, which is opposite to the expectation from the various explanations of the European Muon Collaboration effect. Models incorporating modifications of the gluon structure functions in heavy targets show qualitative agreement with the data.

31525 Comparison of discovery limits for E_6 neutral gauge bosons at future colliders. Capstick, S.; Godfrey, S. (Department of Theoretical Physics, Oxford University, 1 Keble Road, Oxford OX1 3NP, United Kingdom). *Physical Review [Section] D: Particles and Fields;* 37: No. 9, 2466-2473(1 May 1988).

We study and compare the phenomenology of extra E_6 neutral gauge bosons at e^+e^-, ep, and hadron colliders. Our purpose is to compare the discovery reach of the various colliders and see how they compare in studying the phenomenology of extra neutral gauge bosons. We find that of the future colliders, hadron colliders probe the highest mass scales for the existence of extra neutral gauge bosons although precision measurements at e^+e^- colliders, the SLAC Linear Collider and CERN's LEP, at √s = M/sub Z// sub =/ will put tight constraints on models predicting extra neutral gauge bosons. If deviations from the standard model are observed at e^+e^- colliders at √As = M/sub Z/', other measurements, especially those at the DESY ep collider HERA, will be necessary to unravel the physics. We also find that high-precision, low-energy neutral-current experiments will be competitive with e^+e^- and ep colliders for detecting the presence of extra E_6 neutral gauge bosons.

31526 First result on a new measurement of ε'/ε in the neutral-kaon system. Woods, M.; Nishikawa, K.; Patterson, J.R.; Wah, Y.W.; Winstein, B.; Winston, R.; Yamamoto, H.; Swallow, E.C.; Bock, G.J.; Coleman, R.; and others. (The Enrico Fermi Institute and the Department of Physics, The University of Chicago, Chicago, Illinois 60637). *Physical Review Letters;* 60: No. 17, 1695-1698(25 Apr 1988).

A new beam line and detector were constructed to increase statistical precision and greatly reduce systematic uncertainty on the ratio of the CP-nonconserving parameters ε'/ε. Major improvements are discussed together with a result from a first run: ε'/ε = 0.0032 +- 0.0028 (statistical) +- 0.0012 (systematic). The precision is better than earlier measurements yet the result is still consistent with the superweak mechanism (which predicts zero) and that due to Kobayashi and Maskawa. Significantly more data are being collected.

31527 Upper limits on charm-changing neutral-current interactions. Haas, P.; Hempstead, M.; Jensen, T.; Johnson, D.R.; Kagan, H.; Kass, R.; Baringer, P.; McIlwain, R.L.; Miller, D.H.; Ng, C.R.; and others. (Ohio State University, Columbus, Ohio, 43210). *Physical Review Letters;* 60: No. 16, 1614-1617(18 Apr 1988).

We report on a search for charm-changing neutral-current decays and lepton-family-number—nonconserving decays of charmed hadrons using inclusive and exclusive decays of charmed hadrons into oppositely charged dileptons. We find no evidence for such interactions. The upper limits on the branching ratio for inclusive charm decay to dileptons are $B(c\to X\mu^+\mu^-)<1.8\times10^{-2}$, $B(c\to Xe^+e^-)<2.2\times10^{-2}$, and B(c→Xμ/sup +- /e/sup minus-or-plus/)<3.7 x 10^{-2} at 90% confidence level. Upper bounds are also presented for the branching ratios of several exclusive modes.

31528 Neutrino production of same-sign dimuons. Schumm, B.A.; Merritt, F.S.; Oreglia, M.J.; Schellman, H.; Bachmann, K.T.; Bernstein, R.H.; Blair, R.E.; Foudas, C.; Lefmann, W.C.; Leung, W.C.; and others. (Enrico Fermi Institute and Department of PHysics, University of Chicago, Chicago, Illinois 60637). *Physical Review Letters;* 60: No. 16, 1618-1621(18 Apr 1988).

In a sample of 670 000 charged-current neutrino events, 101 $\mu^-\mu^-$ events have been observed, with 30 GeV<E/sub ν/<600 GeV and P/sub μ/>9 GeVc for both muons. After background subtraction, 18.5 +- 13.9 events remain, yielding a prompt rate of (5.5 +- 4.1) x 10^{-3} per charged-current event. A sample of 124 000 antineutrino events yields 15 $\mu^+\mu^+$ events, giving 6.4 +- 4.2 events after background subtraction and a prompt rate of (1.0 +- 0.7) x 10^{-4} per charged-current event. The numbers and kinematic distributions of these events are consistent with standard model sources.

31529 Multiplicity dependence of the transverse-momentum spectrum for centrally produced hadrons in antiproton-proton collisions at √s = 1.8 TeV. Alexopoulos, T.; Allen, C.; Anderson, E.W.; Areti, H.; Banerjee, S.; Beery, P.D.; Biswas, N.N.; Bujak, A.; Carmony, D.D.; Carter, T.; and others. (Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review Letters;* 60: No. 16, 1622-1625(18 Apr 1988).

The transverse momentum of charged particles produced within the pseudorapidity range eta = -0.36 to +1.0 has been measured in p-barp collisions at √s = 1.8 TeV. The charged-particle multiplicity of each event was measured with a 240-element cylindrical hodoscope system covering the range -3.25<eta<3.25. The average transverse momentum as a function of the average charged-particle density per unit of pseudorapidity is presented. Events are observed with average charged-particle density as high as 32 per unit of pseudorapidity.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 30925, 31410, 31416, 31431, 31525, 31567, 31597, 31599, 31601, 31602, 31603, 31604

31530 (BNL—40999) The multistring model VENUS for ultrarelativistic heavy ion collisions. Werner, K. (Brookhaven National Lab., Upton, NY (USA)). Feb 1988. Contract AC02-76CH00016. 7p. (CONF-880260—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007666/JAW.

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

The event generator VENUS is based on a multistring model for heavy ion collisions at ultrarelativistic energies. The model is a straightforward extension of a succeasful model for soft proton-proton scattering, the latter one being consistent with e/sup {plus/}e/sup {minus/} annihilation and deep inelastic lepton scattering. Comparisons of VENUS results with pA and recent AA data alow some statements about intranuclear cascading. 18 refs., 7 figs.

31531 (CBPF-NF—057/87) Three reggeon (string) vertex for N.S. sector with bozonized ghosts. Rego Monteiro, M.A. do. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702628/JAW.

The complete BRST invariant Sciuto-Della Selva-Saito three reggeon vertex for Neveu - Schwarz sector with bosonized reparametrization ghosts and fermionized SUSY ghosts, was constructed.

31532 (CERN-EP—87-50) Compositeness at LEP II. Blondel, A.; Milotti, E.; Bloch, D.; Hamacher, K.; Lyons, L.; Treille, D.; Fesefeldt, H.; Levinson, L.; Maettig, P.; Wermes, N.; Baur, U.; Dominici, D.; Lindner, M.; Mery, P.; Perrottet, M.; Renard, F.; Schildknecht, D.; Schrempp, B.; Schrempp, F.; Schwarzer, K.H.; Zeppenfeld, D. (European Organization for Nuclear Research, Geneva (Switzerland); Fermi National Accelerator Lab., Batavia, IL (USA); Florence Univ. (Italy). Ist. di Fisica Teorica; Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.)). 1987. 40p. (CONF-8609223—10).

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

The purpose of this report is an investigation of the potential of LEP II to unravel possible substructure of leptons, quarks, and perhaps, of the W {pluse}{minus} and Z vector bosons. The main aspects are inclusion of initial-state polarization as an analysing tool; a thorough investigation of e^+e^- yield W^+W^-, more precisely of compositeness-motivated deviations from the Standard Model; an exploration of the potential of LEP II to either confirm or seriously corner the concept of 'nearby' compositeness. Effort was also invested in realistic error analyses and background estimates. 47 refs., 33 figs., 3 tabs.

31533 (CRN-HE—87-04) Generalized no-scale models and classical symmetries of superstrings. Peschanski, R.; Li, S.P.; Savoy, C.A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR). Service de Physique Theorique; Academia Sinica, Nankang, Taipei (CN). Inst. of Physics). (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753480/JAW.

A generalization of no-scale supergravity models is presented where scale transformations and axion-like classical symmetries of the superstrings in four-dimensions are explicitly realized as dilations and translations of the scalar fields in the Kahler manifold. A sufficient condition is that the (dimension one) dilaton fields can be arranged in matrices of a Jordan algebra. This determines four possible classes of irreducible manifolds which are symmetric spaces. An arbitrary number of matter (dimension one half) fields can be included in the Kahler potential in such a way to preserve the algebra of isometries. Among other manifolds, one obtains all Kahler symmetric spaces. This inclusion defines a generalization of flat potential models with zero cosmological constant and scalar-fermion degeneracy except for massive fermions along the flat directions of the scalar potential. For two classes of manifolds and a trilinear superpotential, a SU(1,1) x U(1) subgroup can be promoted to an exact symmetry of the effective Lagrangian.

31534 (DOE/ER/40173—3) Studies in theoretical high energy particle physics: Technical progress report [February 1987-February 1988]. Sukhatme, U.P.; Keung, Wai-Yee; Kovacs, E. (Illinois Univ., Chicago (USA). Dept. of Physics). Feb 1988. Contract FG02-84ER40173. 8p.

This is a technical progress report for grant No. FG02-84ER40173 for the period February 1987 to February 1988. Our research on supersymmetric quantum mechanics has yielded many interesting results. In particular, a systematic approach to the tunneling problem in double well potentials has been developed. Higgs boson related physics at the high energy hadron colliders has been extensively studied.

31535 (IC—87/194) Flavour symmetry breaking in quark vacuum condensates. Paver, N.; Riazuddin; Scadron, M.D. (Trieste Univ. (Italy). Ist. di Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702647/JAW.

We study SU(3) and SU(2) flavour symmetry violations in the vacuum from the viewpoint of nonperturbative quark mass generation and independently from charge symmetry-breaking considerations. The results for the ratios of quark condensates of different flavours are compatible with those of QCD sum rules. However, we find that very large SU(3) violating effects, suggested by some sum rule analyses, are barely accomodated in the present nonperturbative approach. (author). 23 refs, 4 figs.

31536 (IC—87/301) SU(7) electroweak. Ponce, W.A.; Zepeda, A. (International Centre for Theoretical Physics, Trieste (Italy); Instituto Politecnico Nacional, Mexico City. Centro de Investigacion y de Estudios Avanzados). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702701/JAW.

Electroweak unification is obtained in an SU(7) model at a mass scale $3x10^{15} \leqq M \leqq 9x10^{16}$ GeV's with left-right symmetric subgroups and $\sin^2\theta$/sub w/(M)=38. Below M, the model reduces to SU(3)/sub L/xSU(3)/sub R/, the flavor sector of the "trinification" Glashow-Georgi-De Rujula model, or of the E/sub σ/ grand unified theory. This model predicts a natural massless neutrino, and fractionally charged leptons with masses above the TeV regime. (author). 10 refs.

31537 (IC—87/332) O(5)xU(1) electro weak gauge theory and the neutrino oscillations in matter. Samiullah, M.; Hamam, Y.A. (International Centre for Theoretical Physics, Trieste (Italy); Yarmouk Univ., Irbid (Jordan). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702724/JAW.

In the present study we have employed the group O(5)xU(1). The group is economical in the number of gauge bosons, which we associate with each of its generators, and is anomaly free. The left-handed leptons L/sub L//sup T/ident to(υ/sub e/,e,μ,υ/sub μ/)/sub L/ are assigned to the four dimensional spinorial representations of O(5). The right-handed particles are taken to be the singlets of the group. We have briefly sketched the relevant mathematics used in our work. The table of relevant quantum numbers is given. The charge operator is defined. The theory has three sets of gauge bosons (i) analogues of the GWS model (ii) additional charged gauge bosons and (iii) a set of three additional neutral gauge bosons as compared to the GWS model. In this paper we have introduced the neutrino mixing by mixing the additional charged gauge bosons mentioned above. Once the mixing is introduced, utilizing the fact that the refractive index of a neutrino beam scattered by a medium consisting of scattering centres can be related to the forward scattering amplitude, we have developed a theory of neutrino oscillations in matter. The theory is developed in such a way that in the absence of matter the scattering length reduces to the usual scattering length in vacuum. Our work shows that even if the neutrino masses are equal or the neutrinos are massless we still have neutrino oscillations in matter, a result already noted by Wolfenstein. (author). 9 refs.

31538 (IC—87/352) Effects of the d-state quarks on the nucleon electric form factors. Oh, Y.J.; Kong, K.J.; Cheon, I.T. (Yonsei Univ., Seoul (Republic of Korea)). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702738/JAW.

Considering the d-orbital excitation of a quark in the bag, we calculate the nucleon electric form factors in the cloudy bag model. In these calculations, we have taken into account the πNN, $\pi\Delta$N and $\pi\gamma$ form factors though neglecting the c.m. correction. It turns out that the neutron charge form factor is very sensitive to the d-state quark admixture in the overall region of the momentum transfer but the proton charge form factor remains unchanged. Taking the d-state quark admixture in the intermediate state baryons, we can obtain the nucleon rms radii in remarkable agreement with the experimental values. We also investigate the roles of Δ particles in the nucleon charge form factors. (author). 20 refs, 10 figs.

31539 (IC—87/402) Particle physics (1987). Salam, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702745/JAW.

A review of particle physics (1987) is attempted in this paper. (author). 4 tabs.

31540 (IFVE-OTF—87-40) On experimental indications of the existence of a new charged heavy lepton from E_6 generation. Arbuzov, B.A.; Sultanov, S.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; AN Azerbajdzhanskoj SSR, Baku. Inst. Fiziki). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702750/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The interpretation of exotic events with isolated muon observed in e^+e^--collisions (PETRA) at $\sqrt{s} > 46.3$ Gev as the production and decay of charged heavy lepton pairs have been discussed. The naturalness of this interpretation in framework of E_6-theory in the case of charged heavy lepton belonging to muon- or r-family is shown. This interpretation leads to some nontrival predictions. 5 refs.

31541 (ITP—86-118) Study of collective motion in hadronic matter by a pion interferometry method. Averchenkov, V.A.; Makhlin, A.N.; Sinyukov, Yu.M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702816/JAW.

The method allowing to measure the velocities of internal collective motion in hadronic matter at the stage of "freezing" the heat spectra as well as the size and shape determination of the secondary particle generation space-time region is proposed. It is based on the study of Bose-Einstein correlations for pions in the hydrodynamic theory of multiple processes. 16 refs.; 6 figs.

31542 (JINR-E—2-87-430) Pion as Goldstone particle in QCD/sub m/. Pervushin, V.N.; Kallies, W.; Sarikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702820/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The possibility of constructing the modified QCD model (QCD/sub m/) that allows one to give a unique description of the hadron physics at all energies is discussed. QCD/sub m/ is constructed fully in analogy with QED. In QED, nonperturbative phenomena are explained solely by the static potential, and the relativistic operator quantization is necessary for correct relativistic description of the bound states. It is shown that such quantization of the chromodynamics allows the infrared redefinitions of the static potential that would explain the spectroscopy of light and heavy quarkonia, the chiral phenomenological Lagrangians, the confinement and the Veneziano amplitude. 19 refs.

31543 (JINR-E—2-87-506) Correlations among static quark masses. Lewin, K.; Motz, G.B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702821/JAW.

Submitted to the journal Zeit. Phys. .

Nonrelativistic heavy quarkonia potentials with Coulomb and linearly rising limiting behaviour are correlated additively by Taylor expansion extracting the limiting structure and a constant term. Relations between fit parameters of different potentials including the quark masses m/sub b/ and m/sub c/, are obtained. The known stability of the difference m/sub b/-m/sub c/, appears as direct consequence of flavour invariance of the potentials. 11 refs.; 2 figs.; 1 tab.

31544 (JINR-R—2-87-244) Description of deep inelastic processes in terms of wave functions of resting composite systems. Kvinikhidze, A.N.; Khvedelidze, A.M.; Sisakyan, A.N. (AN Gruzinskoj SSR, Tbilisskij Matematicheskij Inst.; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702823/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The lepton-hadron inelastic scattering processes are studied in the rest frame of composite particles. A new perturbative expansion for the description of structure functions is proposed, each term of which posesses the spectral condition. It is demonstrated that, in contrast with infinite momentum frame case, impulse approximation is not valid for describing inelastic limit X/sub B(sub j)/ -> 1 in the rest frame. To obtain leading behaviour of structure functions as X/sub B(sub j)/ -> 1 it is necessary to take account of the interaction of constituents in a final state. The corresponding diagrams are pointed out and their computation in QCD conforms with the results obtained in the null-plane quantum field theory. 7 refs.; 3 figs.

31545 (JINR-R—2-87-485) Electroweak form factors of the πi -> $e^+e^-\nu$/sub e/E^+ decay. Avakyan, E.Z.; Avakyan, S.L.; Ganbold, G.; Dinejkhan, M. (Tashkentskij Gosudarstvennyj Univ. (USSR); Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702824/JAW.

Submitted to the journal JETP Lett. .

The π^+ -> $e^+e^-\nu$/sub e/E^+ decay is studied. The momentum dependences of vector E/sub V/ and axial-vector F/sub A/ form factors as well as their zero momentum values F/sub V/ =0.041, F/sub A/=0.023, R=0.087 are obtained. Parameters y=F/sub A/F/sub V/=0.56, ξ= RF/sub V/=2.1 are also calculated. The obtained values are in good agreement with recent data reported by SINDRUM group. 11 refs.; 1 tab.

31546 (LA-UR—88-737) Portable Pbars, traps that travel. Howe, S.D.; Hynes, M.V.; Picklesimer, A. (Los Alamos National Lab., NM (USA)). Oct 1987. Contract W-7405-ENG-36. 20p. (CONF-8710125—13).

From 2. review and planning workshop on antiproton science and technology; Santa Monica, CA, USA (6 Oct 1987).

The advent of antiproton research utilizing relatively small scale storage devices for very large numbers of these particles opens the possibility of transporting these devices to a research site removed from the accelerator center that produced the antiprotons. Such a portable source of antiprotons could open many new areas of research and make antiprotons available to a new research community. At present antiprotons are available at energies down to 1 MeV. From a portable source these particles can be made available at energies ranging from several tens of kilovolts down to a few millielectron volts. These low energies are in the domain of interest to the atomic and condensed matter physicist. In addition such a source can be used as an injector for an accelerator which could increase the energy domain even further. Moreover, the availability of such a source at a university will open research with antiprotons to a broader range of students than possible at a centralized research facility. This report focuses on the use of ion traps, in particular cylindrical traps, for the antiproton storage device. These devices store the charged antiprotons in a combination of electric and magnet fields. At high enough density and low enough temperature the charged cloud will be susceptible to plasma instabilities. Present day ion trap work is just starting to explore this domain. Our assessment of feasibility is based on what could be done with present day technology and what future technology could achieve. We conclude our report with a radiation safety study that shows that about 10^{11} antiprotons can be transported safely, however the federal guidelines for this transport must be reviewed in detail. More antiprotons than this will require special transportation arrangements. 28 refs., 8 figs.

31547 (LBL—24768) Quark Matter '87: Concluding remarks. Gyulassy, M. (Lawrence Berkeley Lab., CA (USA)). Mar 1988. Contract AC03-76SF00098. 15p. (CONF-8708166—4).

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

This year marked the beginning of the experimental program at BNL and CERN to probe the properties of ultra dense hadronic matter and to search for the quark-gluon plasma phase of matter. Possible implications of the preliminary findings are discussed. Problems needing further theoretical and experimental study are pointed out. 50 refs.

31548 (LUIP—8604) Interactions between hadrons and nuclei. The Lund Monte Carlo - FRITIOF VERSION 1.6. Nilsson-Almqvist, B.; Stenlund, E. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics; Lund Univ. (Sweden). Dept. of Theoretical Physics; Lund Univ. (Sweden). Dept. of Physics). Aug 1986. 18p. (LU-TP—86-14; LUNFD6-NFFK—7074-1-17(1986)). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753012/JAW.

This paper presents a Monte Carlo programme based upon a model, in which a hadron is treated as a vortex line in a superconducting vacuum. The vortex line consists of a hard core which is surrounded by an exponentially damped field. In a soft interaction a momentum transfer between two colliding hadrons is assumed to be due to the overlap of those fields. Having transferred momenta we end up with two longitudinally excited string states which finally fragment into hadrons. When the model is extended into hadron-nucleus and nucleus-nucleus interactions, the incoming hadrons may collide more than once and the excited states continue to collide during their passage through the nucleus. The model shows good agreement with data. FRITIOF 1.6 consists of a main programme where the variables are set and where the user handles the information. Information on the generated event and on the produced particles are stored in common blocks which make the information easy to handle. Furthermore FRITIOF 1.6 contains a set of subroutines for internal use, which administrates the event, gives masses to the excited nucleons etc. The hadronization and the particle decays are taken care of by routines in JETSET 6.2, which perform the hadronization according to the Lund Model for jet fragmentation. The programme is written in FORTRAN 77 and the only non-standard function needed to run the programme is a random number generator, which supplies uniformly distributed random numbers between 0 and 1.

31549 Quarkonium annihilation rates. Kwong, W.; Mackenzie, P.B.; Rosenfeld, R.; Rosner, J.L. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3210-3215(1 Jun 1988).

Recent measurements of ratios of quarkonium annihilation rates are used to evaluate the strong fine-structure constant α_s. Expressions are presented for QCD radiative corrections with α_s referred to the quark-mass scale. We find $\alpha_s(m_b) = 0.179 - 0.008 + 0.009$ from the ratio $\Gamma(\Upsilon \to ggg)/\Gamma(\Upsilon \to gg\gamma)$. The corresponding range of $\Lambda_{\overline{MS}}$ is 146—210 MeV, where MS-bar denotes the modified-minimal-subtraction scheme. The experimentally more precise but theoretically more questionable ratio of the gluonic and muonic widths of Jpsi and Y yields $\alpha_s(m_c) = 0.29 \pm 0.02$, $\alpha_s(m_b) = 0.189 \pm 0.008$ when v^2/c^2 corrections to these ratios for Jpsi and Y are parametrized linearly. Further predictions are made for ratios of rates.

31550 Single-top-quark production in e^+e^- collisions via superstring Yukawa interactions. Barger, V.; Hagiwara, K. (Physics Department, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3320-3322(1 Jun 1988).

The top quark may be singly produced in e^+e^- collisions via the exchange of leptoquarks. We present results for $e^+e^- \to tc$-bar, ct-bar, or tu-bar, ut-bar open and bound-state production in terms of superstring Yukawa couplings.

31551 Top-quark signatures at the Fermilab Tevatron collider. Baer, H.; Barger, V.; Goldberg, H.; Phillips, R.J.N. (Physics Department, Florida State University, Tallahassee, Florida 32303). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3152-3160(1 Jun 1988).

Calculations are presented for the experimental signals arising from top-quark production in pp-bar collisions with semileptonic top decay, for the center-of-mass energy $\sqrt{s} = 2$ TeV available at the Fermilab Tevatron. Both the strong production of tt-bar pairs via QCD and the electroweak channels $W^+ \to tb$-bar, $W^- \to bt$-bar are considered, including gluon bremsstrahlung effects and complete cascade decays of heavy quarks. To separate the t signal from bb-bar, cc-bar, bb-barbb-bar, W, Z, and other backgrounds, we require events containing an isolated lepton along with n jets ($n \geq 2$). The top mass may be determined by the three-jet invariant mass, or a transverse mass formed from the lepton, third hardest jet, and missing p_T. For m_t approx. <80 GeV, confirmation of this signal may be obtained from observation of events containing two isolated leptons at high p_T. From these results, we expect the upcoming run of the Fermilab Tevatron collider to be able to probe t masses up to $m_t = 100$ GeV, assuming sufficient detector resolution.

31552 Strong-interaction effects on the baryon semileptonic decay form factors. Carson, L.J.; Oakes, R.J.; Willcox, C.R. (School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota 55455). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3197-3205(1 Jun 1988).

One-gluon QCD corrections to transition amplitudes describing the baryon semileptonic decays $B' \to B + l + \nu$ have been investigated. All six form factors describing the hadronic matrix element of the weak current between states of the spin-parity 12^+ baryon octet have been calculated in the framework of the MIT bag model, including one-gluon vertex corrections to order α_s. The results provide QCD corrections to the usual phenomenological Cabibbo analyses, including induced second-class form factors. Extensive numerical results are presented and compared with the data, with special attention given to the recent high-statistics results for Λ and Σ^- β decay. The QCD vertex corrections are significant and in general improve the agreement with the data. An exception, however, is g_1/f_1 for Λ β decay, where the QCD vertex corrections do not reconcile the naive predictions with the experimental results. The implications of this and other results for weak-interaction phenomenology are briefly discussed.

31553 Rapidity scaling of multiplicity distributions in a quantum-statistical approach. Fowler, G.N.; Friedlander, E.M.; Pottag, F.W.; Weiner, R.M.; Wheeler, J.; Wilk, G. (Physics Department, University of Marburg, Marburg, West Germany Physics Department, University of Exeter, Exeter, United Kingdom). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3127-3135(1 Jun 1988).

Quantum statistics including a finite coherence length is applied to the study of multiplicity distributions from high-energy hadronic collisions measured in finite rapidity windows. A new scaling property in rapidity ("β scaling") is derived. It contains forward-backward correlations as a special case. Agreement with data is satisfactory. We find strong indications for an increase of chaoticity with energy. Further experimental tests are suggested.

31554 $\Delta\sigma_{tot}/(pp)$ and jet physics. Ramsey, G.P.; Richards, D.; Sivers, D. (Department of Physics, Loyola University, Chicago, Illinois 60626). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3140-3151(1 Jun 1988).

We show that there is a positive contribution to $\Delta\sigma_{tot}(pp;s) = \sigma_{tot}(p(+)p(+);s) - \sigma_{tot}(p(+)p(-);s)$ (where the $+-$ refer to proton helicities) associated with the pointlike scattering of fundamental constituents. The magnitude and energy dependence of this hard-scattering component are related to the small-x behavior of spin-weighted parton densities. Simple arguments imply that this positive contribution would, at very large s, be larger in absolute value than the negative contribution to $\Delta\sigma_{tot}$ predicted from the exchange of the A_1 Reggeon. Measure-

ments of Δσ/sub L/ in the energy range √s = 18—30 GeV should help clarify theoretical ideas associated with the observation of "minijets" and could aid in the prediction of event structure at future high-energy colliders.

31555 **Scalar-leptoquark production at hadron colliders.** Hewett, J.L.; Pakvasa, S. (Ames Laboratory and Department of Physics, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] D: Particles and Fields;* 37: No. 11, 3165-3171(1 Jun 1988).

We examine the single and pair production of scalar leptoquarks (S) in pp and p-barp collisions. The signals and backgrounds for leptoquark production are discussed. We find that the discovery limits for pair production are M/sub S/≃40 GeV at the CERN collider, 120 GeV at the Fermilab Tevatron, and 1.7 TeV at the proposed Superconducting Super Collider. The limits in the case of single S production are found to be model dependent.

31556 **Asymmetry between inclusive charmed and anticharmed modes in B^0, B-bar^0 decay as a measure of CP violation.** Dunietz, I.; Sachs, R.G. (The Enrico Fermi Institute and Department of Physics, The University of Chicago, Chicago, Illinois 60637). *Physical Review [Section] D: Particles and Fields;* 37: No. 11, 3186-3192(1 Jun 1988).

The anticharm-charm asymmetry A(c,c-bar) in the inclusive decay of tagged B^0 and B-bar ^{0} mesons is calculated within the context of the Kobayashi-Maskawa (KM) model. It is shown that A(c,c-bar) is independent of the final-state interactions to a very good approximation. By using estimates of branching ratios, of the differences of the masses of the eigenstates of the B/sub d/^{0} and the B/sub s/^{0}, and of matrix elements of the quark currents, we find chemical bondA(c,c-bar)chemical bond<0.01. If instead of using those estimates of the three sets of parameters we treat them as unknowns, we find that an upper limit on the magnitude of A(c,c-bar) in the context of the model is of the order of 5%. A measurement of A(c,c-bar) leading to a value significantly greater than 5% would be a clear indication that the KM model does not provide a complete description of CP violation.

31557 **Determination of the neutron electric form factor from ^{1}H(e-arrow-right,e)^{1}H.** Donnelly, T.W.; Dubach, J.; Sick, I. (Center for Theoretical Physics, Laboratory for Nuclear Physics dge, Massachusetts 02139). *Physical Review [Section] C: Nuclear Physics;* 37: No. 6, 2320-2325(Jun 1988).

The isospin dependence of the weak neutral current differs from that of the electromagnetic current. A combined analysis of unpolarized and parity-violating polarized electron scattering from nuclei can exploit this difference to extract information about both members of an isospin doublet from measurements involving only one target. Estimates for scattering from the proton suggest that this should constitute an excellent way to determine the electric form factor of the neutron.

31558 **Magnetic monopole with Wilson-loop symmetry breaking.** Lee, B.; Lee, S.H.; Weinberg, E.J.; Lee, K. (Department of Physics, Columbia University, New York, New York 10027). *Physical Review Letters;* 60: No. 22, 2231-2234(30 May 1988).

A nonsingular classical magnetic-monopole solution is obtained in a theory with Wilson-loop symmetry breaking. The solution is used to elucidate the quantization rules governing the magnetic charge, which are more restrictive than those for Higgs monopoles.

31559 **Spin correlations, QCD color transparency, and heavy-quark thresholds in proton-proton scattering.** Brodsky, S.J.; de Teramond, G.F. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review Letters;* 60: No. 19, 1924-1927(9 May 1988).

The strikingly large spin-spin correlation A/sub N//sub N/ observed in pp elastic scattering at p/sub lab/ = 2.5 and 11.75 GeVc and the unexpected energy dependence of absorptive corrections to quasielastic proton-proton scattering in a nuclear target can be interpreted in terms of two J = L = S = 1, B = 2 resonance structures associated with the strange- and charmed-particle production thresholds, interfering with a perturbative QCD background. The results provide support for the "color-transparency" phenomenon predicted in perturbative QCD away from resonances or heavy-quark thresholds.

31560 **Reexamining the Fritzsch-Stech SO(10) model of quarks and leptons.** Gronau, M.; Johnson, R.; Ranfone, S.; Schechter, J. (Physics Department, Technion, 32000 Haifa, Israel). *Physical Review [Section] D: Particles and Fields;* 37: No. 9, 2597-2604(1 May 1988).

In a rather predictive model of the quark and lepton mass matrices we discuss restrictions on the quark and lepton mixings implied by two different phenomena: (1) the Mikheyev-Smirnov-Wolfenstein explanation of the solar-neutrino problem and (2) the recent ARGUS measurements of BB-bar mixing and of charmless B decays involving baryons. We conclude that the model allows for neutrino masses and mixings which may account for matter oscillations of either of the two types ν/sub e/ to ν/sub μ/ or ν/sub e/ to ν/sub tau/. In the quark sector the phenomenology of the model is identical to that of the Fritzsch quark matrix. Within our scheme the simplest interpretation of the recent ARGUS results suggests a large value of m/sub t/ around 80 GeV. The model predicts chemical bondU/sub u//sub b/chemical bond to be around 0.0032.

31561 **Rapidity-interval dependence of multiplicity fluctuation.** Hwa, R.C. (Department of Physics, Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Physical Review [Section] D: Particles and Fields;* 37: No. 9, 2451-2457(1 May 1988).

Specific observations are made regarding the properties of the rapidity-interval dependence of multiplicity distributions in hadron-hadron collisions at high energy. They are presented as focal points for theoretical interpretation. The geometrical branching model is developed to account for the dependence on the rapidity interval. From the data on the normalized moments, information on the impact-parameter dependence of the productivity distribution is extracted.

31562 **Diffusion of charmed quarks in the quark-gluon plasma.** Svetitsky, B. (Department of Nuclear Physics, Weizmann Institute of Science, Rehovot 76100, Israel). *Physical Review [Section] D: Particles and Fields;* 37: No. 9, 2484-2491(1 May 1988).

We calculate the classical drag and diffusion coefficients for a charmed quark propagating in the quark-gluon plasma. Both coefficients turn out rather large, so that (1) a charmed quark created when the plasma is hot will be stopped before propagating 1 fm and (2) subsequent diffusion will be fast. The first effect should serve to increase the yield of J/psi mesons in relativistic heavy-ion collisions, while the second should work in the opposite direction. In any case, the two effects should dominate the dynamics of a cc-bar pair.

31563 **Top-quark decays when m/sub t/≃M/sub W/+m/sub b/.** Gilman, F.J.; Kauffman, R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* 37: No. 9, 2676-2679(1 May 1988). Contract AC03-76SF00515.

We discuss the special situation for decays of the top quark that occurs when m/sub t/≃M/sub W/+m/sub b/ and how it affects exclusive channels Γ(t→b+W)Γ(t→s+W) and the relative proportion of longitudinally and transversely polarized W 's in t decay.

31564 **Hamiltonian reduction of unconstrained and constrained systems.** Faddeev, L.; Jackiw, R. (Steclov Mathematical Institute, Leningrad, Union of Soviet Socialist Republics). *Physical Review Letters;* 60: No. 17, 1692-1694(25 Apr 1988).

Recent Letters and Comments discuss the quantization of self-dual two-dimensional Lagrangeans which describe systems that are not explicitly canonical. We make some remarks on the most efficient method for exhibiting the canonical structure.

31565 QCD predictions for the decay of the tau lepton. Braaten, E. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60208). *Physical Review Letters;* **60**: No. 16, 1606-1609(18 Apr 1988).

The semileptonic decay rate of a heavy lepton is shown to be rigorously calculable by use of perturbative QCD. Even the tau lepton is heavy enough for the perturbative approximation to be accurate. The prediction for the ratio R = Γ(tau→ν/sub tau/ +hadrons)Γ(tau→ν/sub tau/+e⁻ +ν-italic-bar/sub e/) is 3.29, with an uncertainty of about 1% due to the uncertainty in the Λ parameter of QCD. Nonperturbative corrections to this prediction are estimated to be on the order of 1%. More importantly, these corrections are shown to be negative because of a fortuitous cancellation of the leading contribution from the gluon condensate. The resulting prediction is significantly smaller than the present experimental result R = 3.65 +- 0.13.

31566 Quark-gluon amplitudes in the dual expansion. Mangano, M.; Parke, S.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Nuclear Physics [Section] B;* **299**: No. 4, 673-692(18 Apr 1988).

The dual representation, which gives a simple analytical form for purely gluonic amplitudes, is extended to amplitudes which include a quark-antiquark pair. To minimize the calculations, supersymmetry is used to relate the purely gluonic amplitudes to those including a gluino pair from which the quark-antiquark amplitudes are easily deduced. We explicitly give simple analytical forms for the full amplitudes for those multi-parton processes which involve a quark-antiquark pair plus two, three and four gluons.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 31533, 31550, 31556, 31580, 31601, 31602, 31606, 31607, 31610, 31611

31567 (DOE/ER/40291—2) Unusual initial and final state effects in quantum chromodynamics: Progress report, July 15, 1987-March 1, 1988. Nelson, C.A. (State Univ. of New York, Binghamton (USA). Dept. of Physics). Mar 1988. Contract FG02-86ER40291. 10p.

We have constructed fundamental tests which can be used to probe discrete symmetries, and their possible violations, in the required "new physics" beyond the standard model. For spin 0 decay into tau⁺ tau⁻ yielding an observable lepton pair l_3l_3 we have obtained analytically the full sequential decay correlation function $I(E_1, E_2, \cos psi_{12}) = S + \gamma/sub\ CP/D$ in the Higgstechnipion rest frame. For fixed psi_{12}, contour plots of this E_1 energy-E_2 energy correlation function have been made for M/sub H/ = 9 GeV and 70 GeV to show the difference between γ/sub CP/ = +-. We are continuing to investigate our proposal that partons be identified with nearly degenerate, coherent quark-gluon "jet" states in order to settle whether the associated "jet based factorization" is a natural property of QCD and whether it maintains the universality of mass singularities and the factorization of QCD processes into short-distance and long-distance parts. 4 figs.

31568 Global gauge anomalies for simple Lie algebras. Zhang, H.; Okubo, S.; Tosa, Y. (Department of Physics and Astronomy, University of Rochester, Rochester, New York 14627). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 2946-2957(15 May 1988).

We generalize the formula by Elitzur and Nair on the global-anomaly coefficients in even (D = 2n)-dimensional space and analyze global anomalies for Sp(2N), SO(N), and SU(N) groups. In particular, we show that any irreducible representation of any Sp(N) and SU(2) group has no global anomalies in D = 8k dimensions. In D = 8k+4 dimensions, SU(2) has Z_2-type global anomalies only if the spin J of an irreducible representation has the form J = (12(1+4l) = 1)2, (52,9)2,... For any SU(N) group in D = 2n, the global-anomaly coefficients can be expressed in terms of so-called unstable James numbers of Stiefel manifold SU(n+1)SU(n-k) and generalized Dynkin indices Q/sub n/$\mu_1(\omega)$ for SU(n+1).

31569 Symmetry-breaking patterns in (2+1)-dimensional gauge theories. Polychronakos, A.P. (California Institute of Technology, Pasadena, California). *Physical Review Letters;* **60**: No. 19, 1920-1923(9 May 1988).

The possible patterns into which global flavor symmetry and parity can break in three-dimensional Abelian gauge theories are derived. It is found that the two symmetries are incompatible: If one does not break, the other breaks maximally. For an odd number of flavors, in particular, parity conservation is always broken. A simple derivation of the quantum numbers of the vacuum in such theories is also presented.

31570 Supersymmetry breaking in superstring-inspired models. Binetruy, P.; Dawson, S.; Gaillard, M.K.; Hinchliffe, I. (Laboratoire de Physique des Particules, B.P. 909, 74019 Annecy-le-Vieux, France). *Physical Review [Section] D: Particles and Fields;* **37**: No. 9, 2633-2664(1 May 1988).

We study one-loop corrections to a four-dimensional field-theory model, including nonperturbative supersymmetry breaking by gaugino condensation, suggested by a particular compactification of the zero-slope limit of a ten-dimensional superstring theory. We find that, unless the vacuum energy is unbounded from below, it vanishes at the minimum of the effective one-loop-corrected potential. If there is a vacuum with broken supersymmetry, it remains degenerate in one direction and the scales of the effective theory are obtained at one loop in terms of only one (discrete) parameter which remains undetermined. One-loop corrections from the effective theory at scales below Λ/sub c/, where hidden gaugino condensation occurs, generate no soft supersymmetry breaking in the observable sector. The analysis of one-loop effects from scales above Λ/sub c/ suggests that no soft supersymmetry-breaking terms are generated in the gauge-nonsinglet scalar sector, while if gaugino masses m/sub g-italic-tilde/ are generated they are related to the gravitino mass m/sub g-italic-tilde/ by m/sub m-italic-tilde/ = O(1—100)m^3/sub G-italic-tilde/$16\pi^2 m^3$/sub p/. We discuss possibilities for a viable gauge hierarchy and the generalization of our results to other superstring-inspired models.

31571 Factorization of a two-loop four-point superstring amplitude. Yasuda, O. (California Institute of Technology, Pasadena, California 91125). *Physical Review Letters;* **60**: No. 17, 1688-1691(25 Apr 1988).

The behavior of the two-loop four-point graviton amplitude is investigated in the type-II superstring theory, where the genus-two Riemann surface degenerates into two tori. The amplitude turns out to be finite in this limit and it is shown explicitly to the lowest order of the pinching parameter that it produces the product of two one-loop amplitudes, as is expected from the factorization property.

6454 Field Theory

REFER ALSO TO CITATION(S) 31413, 31415, 31431, 31515, 31549, 31558, 31565, 31569, 31570, 31815

31572 (CERN-EP—86-202) Experimental puzzles beyond the Standard Model. Savoy-Navarro, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). 28 Nov 1986. 102p. (CONF-860650—2).

From NATO advanced study institute on techniques and concepts of high energy physics; St. Croix, Virgin Islands, U.S. (19 Jun 1986).

A number of selected topics describe the main features of the present experimental puzzles beyond the Standard Model. They include the search for supersymmetric particles as carried out at e^+e^- colliders in the single-photon experiment (ASP) and at p{ovr p} colliders in the missing-energy measurement (UA1), as well as a discussion of the fifth force from classical mechanics to the extended supergravity theories. This is to illustrate the answer of the present experiments to the possible existence of a superworld. The neutrino physics is then reviewed, starting with the single- and double-beta decay experiments and finishing with the large solar neutrino experiments (GALLEX). The non-accelerator side of the high-energy physics should at some time be able to clarify the

nature of neutrinos (massive or not?, Majorana or Dirac particles?, etc.). Finally, the Higgs sector is discussed. With the present experimental results it still remains untested. While it is requested by the Standard Model, we show how it stands on the threshold of new physics (at the 1 TeV range) and of new technologies. We emphasize the fact that these experimental puzzles are everywhere and that we have to be very smart to solve them. 72 refs., 60 figs., 13 tabs.

31573 **(DOE/ER/03130—TA-394) Three lectures on string field theory.** Jevicki, A. (Brown Univ., Providence, RI (USA). Dept. of Physics). Oct 1987. Contract AC02-76ER03130. 21p. (BROWN/HET—640; COO—3130TA-394). NTIS, PC A; 03; GPO Dep. Order Number DE88006400/JAW.

Presently there are severla major theoretical developments whose goal is to achieve a fundamental understanding of the equations that govern the structure of strign theory. In general, this basic structure is encoded in the interrelationship that exists between 2d conformal invariance and the spacetime gauge symmetries of the string theory. In an effort to formulate these explicitly, one has the approaches based on β-functions in 2d Σ-models, S-matrix functionals, string field theory, integrable analytic geometry, loop space and others. The basic purpose of these lectures is to review some of these approaches and comment on the interrelationships that exist among them. First, we concentrate on first quantized, Polyakov string approach. The basic equations which follow from the requirement of conformal invariance are summarized. The connection with the field theoretic formulation is given vbvased on an S-matrix generating functional method. Both the S-matrix and the field theoretic formulation still leave major open questions. These issues concern the understanding of the theory fo r closed strings and the orgin of general relativity. 55 refs.

31574 **(DOE/ER/40233—3) Topics in gauge theories and the unification of elementary particle interactions: Progress report for period July 1, 1987-March 31, 1988.** Srivastava, Y.N.; Vaughn, M.T. (Northeastern Univ., Boston, MA (USA)). Mar 1988. Contract FG02-85ER40233. 8p.

This report on work done by the principal investigators and their collaborators on: non-scaling phenomena in very high-energy, low p/sub t/ physics; probe of QED vacuum polarization via the Moessbauer effect; computer graphic representations of topological solutions to classical field equations; and p-adic string theory.

31575 **(IC—87/188) Birkhoff and Taub theorems generalized to metrics with conformal symmetries.** Kuang Zhiquan; Liang Canbin. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702642/JAW.

The Birkhoff theorem for spherically symmetric vacuum solutions and the Taub theorem for plane-symmetric vacuum solutions are both generalized to vacuum solutions with conformal symmetries, i.e. it is proved in this paper that any conformally spherically (resp. phane-) symmetric vacuum solution to Einstein equations must be the Schwarzschild (resp. either Taub-Kasner or flat) solution. (author). 4 refs.

31576 **(IC—87/190) String loop effect on the BRST charge.** Das, A.; Nishino, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702644/JAW.

An effective BRST charge Q/sub BRST/ which incorporates the string one-loop corrections is presented for the closed bosonic string in an arbitrary background. The effective σ-model action which leads to such a Q/sub BRST/ is obtained and some consequences are discussed. (author). 14 refs, 1 fig.

31577 **(IC—87/205) Hyper-Kahler metrics and harmonic superspace.** Hassouni, A.E.; Lhallabi, T.; Saidi, E.H.; Oudrhiri-Safiani, E.G. (International Centre for Theoretical Physics, Trieste (Italy); Laboratoire de Physique Theorique, Faculte des Sciences, Rabat (Morocco)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702653/JAW.

Using the harmonic superspace techniques with central charges, we study the U(1) hypermultiplet self-interaction by working out a general class of solutions of the auxiliary field equations of motion in presence of spinor fields. These solutions depend on an extra unfixed degree of freedom ω which can be gauged away through an additional condition. The resulting metric is ω-dependent and is shown to be hyper-Kaehler. The induced scalar potential is discussed. The fermionic solutions are found to be rotated by an extra local SU(2) symmetry leading to the normalization given by Galperin et al. for the vielbein fields. The full spinorial contribution of the model is given in terms of the N=2 on shell multiplet (f/sup i/, ξ, eta-bar). (author). 17 refs.

31578 **(IC—87/208) Spinning string models on group manifolds with twisted boundary conditions.** Huang Chaoshang; Zhao Weidong; Zhao Zhiyong. (Academia Sinica, Beijing, BJ (China). Inst. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702656/JAW.

Spinning string models on M/sub d/xG (M/sub d/ is a d-dimensional Minkowski space and G is a group manifold) with twisted boundary conditions are investigated. The twisted models have the same critical dimension as the corresponding untwisted models. The mass spectra of the twisted models are different from those of the corresponding untwisted models. In particular, massless fermions arise for some non-Abelian groups (author). 11 refs.

31579 **(IC—87/210) Relativistic theory of the Lamb shift based on self energy.** Barut, A.O.; Salamin, Y.I. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702658/JAW.

A study is made to evaluate the Lamb shift to all orders in ($Z\alpha$) using relativistic Dirac Coulomb wavefunctions and without resorting to the dipole approximation. Use is made of the angular integrals and spins sums performed elsewhere exactly. A regularization procedure is given that makes the sum over the positive and negative energy states finite. Finally, the energy shift ΔE/sub n// sup LS/ is given in terms of an integral that may be done numerically. (author). 19 refs.

31580 **(IC—87/212) Euclidean supersymmetry and relativistic two-body systems.** Aydin, Z.Z.; Yilmazer, A.U. (International Centre for Theoretical Physics, Trieste (Italy); Ankara Univ. (Turkey)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702660/JAW.

The supersymmetric generalization of the Schroedinger equation proposed recently by Sokatchev and Stoyanov is enlarged to cover minimal electromagnetic interactions. The model is extended to two-particle systems, and bound state equations for scalar and spinor particles are written down in a unified manner. (author). 19 refs.

31581 **(IC—87/238) Models of two-dimensional conformal quantum field theory with Z/sub n/-symmetry.** Fateev, V.A.; Lykyanov, S.L. (International Centre for Theoretical Physics, Trieste (Italy); AN SSSR, Moscow. Inst. Teoreticheskoj Fiziki). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702668/JAW.

An infinite set of conformally invariant solutions of the two-dimensional quantum field theory, possessing a global symmetry Z/sub n/ is constructed. These solutions can describe the critical be-

haviour of Z/sub n/-symmetric statistical systems. (authors). 20 refs.

31582 **(IC—87/265) Generic action for strings.** Gamboa, J.; Tapia, V. (International Centre for Theoretical Physics, Trieste (Italy); International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702671/JAW.

We show that the action for the ordinary string recently proposed by Marnelius is equivalent to the Nambu-Goto action, not by elimination of the Lagrange multiplier but by means of its field equation, but better based on the constraints algebra. We show, furthermore, that the zero tension limit coincides with the null string. (author). 4 refs.

31583 **(IC—87/283) Another scheme for quantization of scale invariant gauge theories.** Hortacsu, M. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702685/JAW.

A new scheme is proposed for the quantization of scale invariant gauge theories for all even dimensions when they are minimally coupled to a spinor field. A cut-off procedure suggests an algorithm which may regularize the theory. (author). 10 refs.

31584 **(IC—87/294) On nonlinear equations admitting soliton solutions with a "de Broglie phase".** Baby, B.V.; Barut, A.O. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702694/JAW.

Some new classes of solutions are given for different families of nonlinear equations which have a localized envelope and a complex phase. Energy and momentum of these solutions and their possible applications as a model of a quantum particle are discussed. (author). 16 refs, 4 figs.

31585 **(IC—87/296) Ground states representation and the square root of the bosonic string.** Gamboa, J.; Zanelli, J. (Chile Univ., Santiago. Dept. de Fisica). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702696/JAW.

The supersymmetric extension of a bosonic system using the ground state wave function representation developed by Gozzi and these authors, is now applied to the Nambu-Goto string. It is shown that this prescription naturally leads to the Ramond and Neveu-Schwarz models. (author). 18 refs.

31586 **(IC—87/300) Two dimensional untwisted (4,4), twisted (4,4-bar) and chiral supersymmetric non linear σ-models.** Lhallabi, T.; Saidi, E.H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702700/JAW.

D=2 N=(4,4) harmonic superspace analysis is developed. The underlying untwisted (4,4) non linear σ-models are studied. A method of deriving chiral (4,0) and (0,4) models is presented. The Lagrange superparameter leading to the constraint specifying the hyperkahler manifold structure is predicted and its relation to the matter superfield is stated in a covariant way. A known construction is recovered. We show also that (4,4) model is not a direct sum of the chiral ones. Finally a twisted (4,4-bar) model is obtained. (author). 28 refs.

31587 **(IC—87/306) Twisted d=2 (4,4) supersymmetric non-linear σ-models are specified by one hyperKaehler potential.** Saidi, E.H. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702705/JAW.

We construct a class of d=2 (4,4) supersymmetric non-linear σ-models completely specified by one Kaehlerian-like potential. The bosonic manifold has an SO(4) isometry group. (author). 13 refs.

31588 **(IC—87/307) Introduction to string theory.** Randjbar-Daemi, S.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 44p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702706/JAW.

These notes are based on a set of six introductory lectures given jointly by the authors. After developing the canonical methods we discuss the covariant quantization of the bosonic as well as the fermionic string. Conformal field theory methods are also introduced and used to calculate the anomaly coefficient, c, as well as the critical dimensions for bosonic and superstrings. We briefly sketch the BRS quantization and then offer an elementary derivation of the anomaly in the ghost number current. Finally, we address the one-loop partition function of the bosonic string and the question of SL(2,Z) invariance. (author). 15 refs.

31589 **(IC—87/319) Intrinsic-normal-ordered vertex operators from the multiloop N-tachyon amplitude.** Aldazabal, G.; Nunez, C.; Bonini, M.; Iengo, R. (International Centre for Theoretical Physics, Trieste (Italy); International School of Advanced Studies, Trieste (Italy)). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702713/JAW.

We construct vertex operators for arbitrary mass level states of the closed bosonic string. Starting from a generalization of the Koba-Nielsen amplitude which is suitable for an arbitrary genus Riemann surface, we read the vertex operators from the residues of the poles for the intermediate states. Since the original expression is metric independent and normal ordered without the need of inventing any regularization scheme, our vertex operators also possess these properties. We discuss their general features. (author). 17 refs.

31590 **(IC—87/320) Holomorphic geometry of interacting string.** Saito Takesi; Wu Ke. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702714/JAW.

We apply the geometric quantization of Bowick and Rajeev to interacting bosonic strings. We calculate the total curvature of the two bundles over Diff S^1S^1. The requirement of vanishing of the total curvature leads not only to the critical dimension d=26, but also to constraint equations for vertex operators. We find two solutions to these equations for external scalar fields which are interacting with the open string. Other interactions with vector field, weak gravitational field and so on are also discussed. (author). 8 refs.

31591 **(IC—87/324) One-loop amplitudes and divergences in unoriented string theories.** Tanii Yoshiaki. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702717/JAW.

The one-loop amplitudes of Klein bottle, cylinder and Moebius strip topologies with external closed string tachyons are explicitly obtained in the bosonic string theories. The divergences in these amplitudes are interpreted as due to tree-level and one-loop dilaton tadpoles. (author). 16 refs.

31592 **(IC—87/326) Kaluza-Klein approach to the classical model of the Dirac electron.** Barut, A.O.; Pavsic, M. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702719/JAW.

The classical theory of the electron with Zitterbewegung is formulated in a five-dimensional curved Kaluza-Klein metric which introduces the electromagnetic field A/sub μ/ and a scalar field phi. The interaction of spin with the electromagnetic field which has not been considered in our previous works arises straightforwardly from the five-dimensional theory. (author). 9 refs.

31593 **(IC—87/329) Holomorphic structure of closed strings: Left moving sector.** Li Miao. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702722/JAW.

We present here some consideration which generalizes the result in a work of Pilch and Warner to a half sector of closed strings and SUPER DIFF S^1S^1. (author). 10 refs.

31594 **(IC—87/361) Low energy limit of parity-violating amplitudes and anomaly cancellations in type-I superstring.** Tanii Yoshiaki. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702741/JAW.

The low energy limit of parity-violating one-loop amplitudes with external six gauge bosons is studied in type-I superstring theory. The leading contributions come from the integration region near the boundaries of moduli space and give the same anomaly as in the effective particle field theory. (author). 21 refs.

31595 **(IC—87/370) Recent developments in the light-cone gauge approach to superstrings.** Taylor, J.G. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702744/JAW.

The question of stabilising the vacuum and closing the supersymmetry algebra is answered by presenting an analysis of the closure of the algebra using equal-time commutation relations for the second-quantized closed superstring field operators. A new term, quartic in the closed fields, is presented both for the super-charges and the Hamiltonian. The effect of the latter term on multi-loop string amplitudes is briefly analysed for type II and heterotic superstrings. (author). 23 refs.

31596 **(LAPP-TH—205-87) On the construction of convex effective potential.** Eliashvili, M. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Dec 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753486/JAW.

It is argued that the convexity property imposed on the effective potential can be satisfied only under the precise specification of the boundary conditions in the functional integral representation of the Green's functions generating functionals. The Schwinger's functionals and effective potentials, which are calculated without such a specification, cannot be expected to be a convex function.

31597 **(LAPP-TH—207-87) Structure of basic Lie superalgebras and of their affine extensions.** Frappat, L.; Sorba, P.; Sciarrino, A. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules; Istituto Nazionale di Fisica Nucleare, Naples (IT)). (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Dec 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753601/JAW.

We generalize to the case of superalgebras several properties of simple Lie algebras involving the use of Dynkin diagrams. If to a simple Lie algebra can be associated one Dynkin diagram, it is a finite set of non equivalent ones which can be constructed for a basic superalgebra (or B.S.A.). The knowledge of these diagrams, which can be obtained for each B.S.A. in a systematic way, allos us to deduce the regular subsuperalgebras of a B.S.A. The symmetries of the Dynkin diagrams are related to outer automorphisms of B.S.A. and lead to some singular subsuperalgebras. Finally we consider the extended Dynkin diagrams in order to classify the affine B.S.A. and use their symmetries to construct the twisted basic superalgebras.

31598 **(LBL—24319) The geometry of the Virasoro group for physicists.** Zumino, B. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 19p. (CONF-8708230—1). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007374/JAW.

From NATO advanced studies institute summer school on particle physics; Cargese, France (3 Aug 1987).

Diff(S^1), the group of reparametrizations of the circle, is known as the Virasoro group in string theory. Reparametrizations keeping fixed a point of the circle form the quotient space Diff(S^1)/S^1. The geometry of this space is relevant for string theory and string field theory. We describe this space as an infinite dimensional complex manifold with a Kaehler metric and compute ist Riemann tensor and its Ricci tensor. 7 refs.

31599 **Semileptonic decays of heavy top mesons.** Jones, L.M. (Physics Department, University of Illinois at Urbana—Champaign, 1110 West Green Street, Urbana, Illinois 61801). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3176-3185(1 Jun 1988).

A QCD approach is used to predict jets of hadrons in semileptonic decays of top-quark mesons with masses between 50 and 190 GeV. Two different models are used to set up the kinematics of the final state; results are compared with a third (naive) model in which there is only one jet. We find that in this mass range two jets are frequently needed to contain all the hadrons in the final state. Fortunately, more jets are probably not needed. The mass range between 80 and 100 GeV is discussed in detail because the proximity of the top mass to the W mass produces some interesting features.

31600 **Color correlations in QCD plasma.** Parikh, J.C.; Siemens, P.J. (Physical Research Laboratory, Navrangpura, Ahmedabad-380009, India). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3246-3251(1 Jun 1988).

Perturbative QCD and the random-phase approximation are used to study the current-current correlation function in quark-gluon plasma. The calculations show that there are damped collective oscillations in the system. An estimate of the Debye screening length gives a value of about 0.5 fm at a temperature of 250 MeV.

31601 **Realistic pseudoscalar-vector chiral Lagrangian and its soliton excitations.** Jain, P.; Johnson, R.; Meissner, U.; Park, N.W.; Schechter, J. (Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3252-3266(1 Jun 1988).

A reasonable low-energy chiral Lagrangian of vectors and pseudoscalars involves three a priori unknown coefficients for terms proportional to the Levi-Civita symbol ϵ/sub μ//sub ν//sub α//sub β/. We argue that these cannot, from a theoretical standpoint, be reliably determined by consideration of electromagnetic processes. Hence we use purely strong-interaction processes which enable us to determine two out of three of these. We examine the nucleon as a soliton excitation in the model and find that adjustment of the third parameter does not greatly change the, in most respects accurate, description of the nucleon obtained in a previous treatment by Meissner, Kaiser, and Weise. The paper includes a new and careful formulation of the addition of electromagnetism to the full Lagrangian.

31602 **Hadrons in an SL-bar(4,openR) classification.** Ne'eman, Y.; S-hacekijacki, D. (Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv, Israel). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3267-3283(1 Jun 1988).

Covariance, as commonly realized by relativistic fields carrying nonunitary representations of GL-bar(4,openR), also provides infinite-component world spinorial and tensorial "manifields." These can be used to describe the phenomenology of hadron excitations, whatever the precise QCD mechanism. Energy levels follow the approximate symmetry due to the geometric features of color confinement. We assign to each of several manifields the relevant hadronic system for a single flavor. The presently known resonances are successfully accommodated and various missing states predicted.

31603 **Hyperfine splitting of P states in heavy quarkonia.** Pantaleone, J.; Tye, S.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *D: Particles and Fields;* **37**: No. 11, 3337-3339(1 Jun 1988).

The splitting between the $^1P_1$ and the center of gravity of the ^3P/sub j/ states of heavy quarkonia is evaluated using the perturbative QCD expression for the hyperfine potential. The theoreti-

cal result is about 1% of the absolute fine-structure splitting and disagrees with an experimental value.

31604 **Explicit σ meson, topology, and the large-N limit of the Skyrmion.** Cohen, T.D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] D: Particles and Fields;* **37**: No. 11, 3344-3347(1 Jun 1988).

A generalization of the Skyrme model based on the linear σ model, i.e., with an explicit σ-meson degree of freedom, is proposed. Although the winding number (i.e., the baryon number) of such a model is not strictly conserved at the semiclassical level, it is shown that in the large-N limit all processes which violate baryon conservation are exponentially suppressed. The possibility that higher-order 1/N effects will keep baryon conservation exact at finite N is discussed as are possible phenomenological advantages of this kind of model.

31605 **Conformal field theory and the geometry of second quantization.** Sanielevici, M.N.; Semenoff, G.W. (Center for Theoretical Physics, Laboratory for Nuclear Science dge, Massachusetts 02139). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 2934-2945(15 May 1988).

We examine the holomorphic representation of the quantum mechanics of two-dimensional Weyl-Majorana fermions coupled to a static background geometry. We give an explicit construction of the states and consider their parallel transport on the space of background geometries. We use this parallel transport to exhibit the anomalous transformation properties of quantum states under diffeomorphisms of the background metric and show that the central extension of the diffeomorphism algebra is given by the adiabatic curvature of the vacuum state. We show that the adiabatic effective action exhibits a gravitational anomaly which is also directly related to the adiabatic curvature. We present explicit formulas for Berry's connection and curvature for the quantum states of the theory.

31606 **Exact ground-state properties of SU(3) Hamiltonian lattice gauge theory.** Chin, S.A.; Long, C.; Robson, D. (Center for Theoretical Physics, Department of Physics, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3001-3005(15 May 1988).

We solve for the exact ground state of SU(3) Hamiltonian lattice gauge theory via the guided-random-walk algorithm. We show that the algorithm is effective in calculating the ground-state energy with excellent precision. By comparing exact and variational ground-state results in the case of SU(2) and SU(3), we further demonstrate that variational calculations based on the independent-plaquette trial function improve with increasing N from N = 2 to N = 3.

31607 **Improved variational wave functions for SU(3) Hamiltonian lattice gauge theory.** Long, C.; Robson, D.; Chin, S.A. (Department of Physics, Florida State University, Tallahassee, Florida 32306). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3006-3009(15 May 1988).

We study improved variational wave functions for SU(3) Hamiltonian lattice gauge theory by comparing variational ground-state energies and scalar-glueball masses. Variational wave functions that include twisted six-link Wilson loops and plaquettes are significantly better than those that include only plaquettes for calculating the ground-state energy and the scalar-glueball mass. The calculated glueball mass approaches scaling, suggesting that further improvements can be made by including more loops.

31608 **Variational calculation of the spectrum of two-dimensional phi^4 theory in light-front field theory.** Harindranath, A.; Vary, J.P. (Physics Department, The Ohio State University, Columbus, Ohio 43210). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3010-3013(15 May 1988).

We demonstrate that a coherent state may be a valid vacuum in light-front field theory. Then by minimizing the sum of the expectation values of the light-front Hamiltonian and the momentum operators in a variational trial state, we evaluate the ground state (vacuum) of two-dimensional phi^4 field theory. The resulting expectation value in the coherent state is identical with the result of the effective-potential method in the equal-time formulation. Thus we demonstrate how to solve for the ground state of the strong-coupling $(\text{phi}^4)_2$ problem on the light front. We also discuss the calculation of excited states.

31609 **Regulating 1(k$^+$)/sup n/ singularities in discrete light-cone quantization.** Tang, A.C. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3014-3018(15 May 1988). Contract AC03-76SF00515.

Deficiencies with the principal-value method of calculating (1ipartial$^+$)/sup n/e$^-$(i2)k$^+$x$^-$ in the framework of light-cone quantization are described and a method of solving these difficulties using regulated Green's functions and boundary conditions is proposed.

31610 **N = (1/2 hidden symmetries.** Braden, H.W. (Institute of Field Physics, Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3019-3023(15 May 1988).

A family of nonlinear (1,0) supersymmetries with central charge is exhibited in nonlinear σ models for a large class of Riemannian manifolds including the group manifolds. In particular, (2,0) supersymmetry on these latter manifolds is discussed.

31611 **Vacuum and excited states of Coulomb-gauge SU(n) Yang-Mills fields.** Cutkosky, R.E.; Wang, K.C. (Physics Department, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 3024-3032(15 May 1988).

Properties of the quantized SU(n) Yang-Mills fields, for n = 2, 3, and 4, have been studied numerically. We apply the Hamiltonian formalism to the continuum theory, with a truncated momentum expansion in a finite volume, and have examined states in the vacuum sector using variational methods in the Coulomb gauge. The results depend on the strength of the interaction constant α, with a transition at $n\alpha \sim 1$. For small α, there is a gap between excited-state energies and the vacuum energy, but the excited 0^{++} states correspond to pairs of weakly interacting transverse gluons. For larger α, the excited states are associated with a collective degree of freedom and can be identified with a glueball. There is no evidence for the existence of an instability associated with magnetic interactions.

31612 **Particle-antiparticle and hybrid bound states involving exotic colored fermions.** Chang, C.; Ono, S. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510 and Institute of Theoretical Physics, Academia Sinica, P.O. Box 2735, Beijing, China). *Physical Review [Section] D: Particles and Fields;* **37**: No. 9, 2605-2617(1 May 1988).

The spectra and the basic properties of particle-antiparticle and hybrid bound states of the exotic colored fermions, which occur in some of the composite models and certain theoretical models, are studied systematically, based on the QCD and bag-model considerations.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 31547

31613 **(BNL-NCS—40503) Procedures manual for the Evaluated Nuclear Structure Data File.** Bhat, M.R. (ed.). (National Nuclear Data Center, Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 191p. NTIS, PC A09; GPO Dep. Order Number DE88007382/JAW.

This manual is a collection of various notes, memoranda and instructions on procedures for the evaluation of data in the Evaluated Nuclear Structure Data File (ENSDF). They were distributed at different times over the past few years to the evaluators of nuclear structure data and some of them were not readily avaialble. Hence, they have been collected in this manual for ease of reference by the evaluators of the international Nuclear Structure and Decay Data (NSDD) network contribute mass-chains to the ENSDF. Some new articles were written specifically for this manual and others are reivsions of earlier versions.

31614 **(BNL-NCS—40836) NNDC [National Nuclear Data Center] support for fusion nuclear data needs.** Dunford, C.L. (Brookhaven National Lab., Upton, NY (USA)). 1988. Contract AC02-76CH00016. 5p. (CONF-880172—1).

From US/Japan workshop on fusion neutronics; Los Angeles, CA, USA (27 Jan 1988).

The National Data Center (NNDC) located at Brookhaven National Laboratory is an outgrowth of the Sigma Center founded by D.J. Hughes to compile low energy neutron reaction data in the 1950's. The center has played a lead role in the production of evaluated nuclear data (ENDF/B) for the United States nuclear power program. This data file, now in its sixth version, is produced as a cooperative effort of many DOE funded organizations via the Cross Section Evaluation Working Group (GSEWG). The NNDC's role, in addition to providing the structure and leadership for CSEWG, is to supply compiled bibliographic and experimental data and provide file processing, checking, distribution and documentation services. In the past, the NNDC has also produced nuclear data evaluations.

31615 **(JAERI-M—88-067) Japanese list of requests for nuclear data.** Igarasi, Sin-iti (comp.). (Japan Atomic Energy Research Inst., Tokyo; Japanese Nuclear Data Committee, Tokai, Ibaraki). Mar 1988. 32p. (NEANDC(J)—128/A; INDC(JPN)—114/G). JAERI, Tokai-mura, Naka-gun, Ibaraki-ken, 319-11 Japan. Order Number TI88008630/JAW.

Requests for nuclear data for 1987 are presented. They are 49 for fission reactor, 25 for fusion reactor, and 4 for safeguards. This report contains these 78 requests, and also 66 requests which should be withdrawn from the previous WRENDA list. These withdrawn requests are 23 for fission reactor, 32 for fusion reactor, 9 for safeguards, and 2 for others.

31616 **(JINR-R—6-87-219) Determination of multipolarities of γ-transitions in La,Gd,Tb,Dy,Ho,Er,Tm,Yb nuclei on the basis of modified rechniques of beta-spectrogram processing.** Baratova, M.A.; Gromov, K.Ya.; Islamov, T.A.; Kononenko, G.A.; Kholmatov, A.Kh.; Tsupko-Sitnikov, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702829/JAW.

Submitted to the journal Izv. AN SSSR, Ser. Fiz. and to the Organizing Comittee of the 37. Conference on nuclear spectroscopy and nuclear structure, Yurmala, Apr 1987.

Spectra of internal conversion electrons from magnetic spectrographs on the basis of a modified procedure of processing the beta-spectrograms were studied. Multipolarities of some γ-transitions in /sup 133,135/La, /sup 149,151,152,154/Gd, /sup 153,155/Tb, /sup 155,156,158,159,160,161/Dy, /sup 160,161/Ho, $^{161-167}$Er, /sup 167,169/Tm, /sup 167,169,171/Yb nuclei were determined. 61 transitions have been considered. Multipolarities of two transitions of 177 and 198 keV Tm transitions have been determined taking into account the penetration of atomic electrons into nuclei. Along with δ^2 for these transitions nuclear parameters of penetration λ have been also determined. For mixed multipolarities transitions the reduced probabilities and forbiddance factors by Weisskopf have been also calculated. 44 refs.; 4 figs.; 3 tabs.

31617 **(JINR-R—7-87-558) Spectrum temperature and duration of particle emission at excitation energy of nucleus higher than 1 MeV/nucleon.** Karamyan, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702830/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Experimental observation of highly excited quasi-equilibrium nuclear systems formed in reactions will heavy ions in 10-60 MeV-nucleon energy range is considered. The data on spectrum and multiplicity of charged particles and neutrons are used for nuclear temperature determination and for examination of the nuclear matter state equation within the 1-5 MeVnucleon excitation energy range. A new possibility of estimation of duration of about 10^{-21}-10^{-19} is proposed on the basis of comparison between particle emission duration and Coulomb field acceleration time for fragments. 30 refs.; 3 figs.

31618 **(LA—11153-MS) Automated MCNP photon source generation for arbitrary configurations of radioactive materials and first-principles calculations of photon detector responses.** Estes, G.P.;Schrandt, R.G.;Kriese, J.T. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 24p.

A patch to the Los Alamos Monte Carlo code MCNP has been developed that automates the generation of source descriptions for photons from arbitrary mixtures and configurations of radioactive isotopes. Photon branching ratios for decay processes are obtained from national and international data bases and accesed directly from computer files. Code user input is generally confined to readily available information such as density, isotopic weight fractions, atomic numbers, etc. of isotopes and material compositions. The availbility of this capability in conjunction with the "generalized source" capability of MCNP Version 3A makes possible the rapid and accurate description of photon sources from complex mixtures and configurations of radioactive materials, resulting in imporved radiation transport predictive capabilities. This capability is combined with a first - principles calculation of photon spectrometer response - functions for NaI, BGO, and HPGe for Eγ {approx←lt} 1 MeV. 25 refs., 1 fig., 4 tabs.

31619 **(LUIP—8602) Relativistic heavy ion reactions.** Andersson, B.; Gustafson, G.; Nilsson-Almqvist, B.; Garpman, S.; Gustafsson, H.A.A.; Otterlund, I.; Stenlund, E. (Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics; Lund Univ. (Sweden). Dept. of Physics). Apr 1986. 107p. (LUNFD6-NFFK—7070-1-105-(1986)). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88753011/JAW.

Relativistic heavy ion reactions are reviewed in terms of our present understanding of some selected experimental results from the LBL Bevalac and the CERN ISR. The Lund Model for nucleus-nucleus collisions is presented and its power of predictivity is illustrated. (authors).

6511 Experimental Techniques

31620 **(CERN-EP—87-52) Resonance ionization mass spectroscopy for nuclear research and trace analysis.** Kluge, H.J. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik; European Organization for Nuclear Research, Geneva (Switzerland)). 10 Mar 1987. 37p. (CONF-8701111—1).

From Workshop on modern optics, lasers and laser spectroscopy; Kanpur, India (19 Jan 1987).

Resonance ionization mass spectroscopy (RIMS) has been applied, firstly, to a study of the nuclear properties of short-lived Au isotopes at the on-line separator ISOLDE at CERN and, secondly, to a trace-analysis experiment of Pu. 31 refs., 13 figs., 1 tab.

31621 **(DOE/ER/40350—1) Multiple coil pulsed magnetic resonance method to measure the SSC bending magnet multipole moments: Technical progress report for the period March 1, 1987 to March 31, 1988.** Clark, W.G. (California Univ., Los Angeles (USA). Dept. of Physics). 18 Mar 1988. Contract AC02-87ER40350. 5p.

The main goals for the first year of this project were to design, build, and test an 8-coil prototype pulsed NMR system for measuring SSC bending magnet Multipole Moment Coefficients (MMS) as a test of the feasibility of the method. This instrument operates at a frequency of 10 MHz (SSC injection field) with a short (approx. 1.3 m) probe using ^{3}He at low temperatures or pro-

tons in a water-glycerine mixture at ambient temperature as the working substance. The steps of this part of the program that have been completed are discussed briefly.

31622 **(UCID—18987-88) Report to the DOE Nuclear Data Committee, 1988.** Struble, G.L.; White, R.M. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 24p.

This paper contains a collection of short articles dealing with calculations and measurement of assortetd nuclear data. Such data consists of reaction cross sections, R-matrix calculations, angular distributions, transition rates, energy level descriptions, dipole strength functions, and excitation functions. (LSP)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

31623 **Low-energy neutron-proton analyzing power and the new Bonn potential and Paris potential predictions.** Tornow, W.; Howell, C.R.; Roberts, M.L.; Felsher, P.D.; Chen, Z.M.; Walter, R.L.; Mertens, G.; S-haceklaus, I. (Department of Physics, Duke University, Durham, North Carolina 27706). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2326-2331(Jun 1988).

Instrumental asymmetries recently observed by Haeberli and co-workers, limit the accuracy of neutron-proton analyzing power A/sub y/(θ) data. These instrumental effects are discussed and calculated for previously published n-p A/sub y/(θ) data at 16.9 MeV. To enable these calculations, the analyzing power for the ^{2}H(d-arrow-right,n)^{3}He reaction was measured at small angles. Additional n-p A/sub y/(θ) data at extreme backward angles, obtained via proton recoil detection, are also reported for this energy in this paper. The composite data set is compared to calculations based on the new Bonn NN potential, the Paris NN potential, and to the recent NN phase-shift solution of Arndt. In addition, a detailed comparison between A/sub y/(θ) calculated from the new Bonn and the Paris potentials between 10 and 50 MeV is shown to reveal unexpectedly large relative differences. The experimental data in this energy range are better described by the Paris potential than by the new Bonn potential.

31624 **Analyzing powers for the reaction ^{2}H(p-arrow-right,γ)^{3}He at 800 MeV.** Adams, G.S.;Hoeistad, B.;Laget, J.M.;Aas, B.;Jones, K.;McGill, J.A.;Blanpied, G.S.;Mishra, C.S.;Mize, W.K.;Pignault, G. (Physics Department, Rensselaer Polytechnic Institute, Troy, New York 12180). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1341-1344(Mar 1988).

Analyzing powers have been measured for the reaction ^{2}H(p-arrow-right,γ)^{3}He at a proton beam energy of 800 MeV. The results are in good agreement with microscopic calculations. At this energy the data are most sensitive to the meson-exchange amplitudes. Proton initial-state interactions also play an important role.

31625 **Elastic scattering of 179.3 MeV antiprotons by deuterium.** Bruge, G.;Garreta, D.;Birien, P.;Catz, H.;Chaumeaux, A.;Janouin, S.;Legrand, D.;Lemaire, M.C.;Mayer, B.;Pain, J. (Departement de Physique Nucleaires/Moyenne Energie, Centre d'Etudes Nucleaires de Saclay, 91191 Gif-sur-Yvette Cedex, France). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1345-1346(Mar 1988).

The angular distribution for elastic scattering of 179.3 MeV antiprotons by deuterium has been measured. The data should provide further constraints on the elementary p-n amplitudes.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

31626 **(CONF-870339—7) Preliminary results from collisions between 3.2-TeV ^{16}O and target nuclei of C, Cu, and Au.** (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

We have presented preliminary WA80 data from interactions of ^{16}O with C, Cu, and Au at 60 and 200 GeVnucleon. These have included total charged-particle multiplicity distributions and transverse energy distributions. Ranges of transverse momentum per particle and of possible energy densities were discussed. Some of the unique features of WA80 were stressed. These are: complete coverage of the target rapidity region, complete coverage of charged-particle multiplicity measurement, and measurement of intrinsic photons. WA80 was the only experiment with no magnetic analysis and the only large-scale experiment to obtain production data during the 1986 run which did not involve, primarily, the reconfiguration of an existing SPS experiment.

31627 **(CONF-880161—1) Energy measurements in oxygen-induced reactions at 60 A GeV and 200 A GeV.** Awes, T.C.; Albrecht, R.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Dragon, L.; Ferguson, R.L.; Franz, A.; Garpman, S.; Glasow, R.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.W.; Kristiansson, P.; Lee, I.Y.; Lohner, H.; Lund, I.; Obenshain, F.E.; Oskarsson, A.; Otterlund, I.; Peitzmann, T.; Persson, S.; Plasil, F.; Poskanzer, A.M.; Purschke, M.; Ritter, H.G.; Santo, R.; Schmidt, H.R.; Siemiarczuk, T.; Sorensen, S.P.; Stenlund, E.; Young, G.R. (Oak Ridge National Lab., TN (USA); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Muenster Univ. (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Lund Univ. (Sweden)). 1988. Contract AC05-84OR21400. 17p.

From 16. international workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (18 Jan 1988).

In an effort to isolate characteristic features of nucleus-nucleus collisions (e.g., collective phenomena) from those that may be expected on the basis of a linear superposition of nuelceon-nucleon collisions, we will compare measured quantities with calculations that reproduce data from nucleon-induced reactions and that make predictions for nucleus-nucleus reactions. While several models are available for this procedure, none has yet been demonstrated to have clear advantages over the others. Consequently, we have chosen to make comparisons with the LUND model for high-energy nucleus-nucleus interactions (FRITIOF). Effects of detector acceptance and of trigger bias have been included in all FRITIOF simulations shown in this work. In describing the nuclear density, the radius parameter r/sub O/ = 1.10 fm has been used for the Woods-Saxon distributions. This results in somewhat larger sizes of the light nuclei as compared to the standard FRITIOF parameter selection, but is in better agreement with results for the nuclear density distribution from electron scattering. 17 refs., 4 figs., 1 tab.

31628 **(DOE/ER/40147—5) Nuclear interactions of high energy heavy ions and applications in astrophysics: Technical progress report, 1 April 1987-31 March 1988.** Wefel, J.P. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 28 Dec 1987. Contract FG05-84ER40147. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006528/JAW.

During the past year of activity at Louisiana State University we have made significant progress in the data analysis, in new experimental runs and in hardware development for experiments scheduled for Bevalac time in Spring '88. We have resolved several experimental problems associated with background in the 225 MeV-nucleon ^{16}O dataset and now have reliable longitudinal momentum distribution at this energy. We habe finished the telescope calibration for the 170 and 360 MeVnucleaon ^{16}O datasets and have preliminary angular distributions. With the University of Siegen group, we have developed and tested a new drift chamber system to provide position sensing for our planned experiments. New data on total charge changing cross sections for ^{28}Si was acquired at four beam energies, and this dataset is currently being analyzed. We are finishing modifications on the forty channels of preamplifiers and shaping amplifiers used in this experiment, constructing new hardware to mate the drift chamber scoper and new solid state detectors together, and are developing new on-11 ne monitoring software for the coming runs with ^{28}Si, and ^{20}Ne. 16 figs.

31629 **(JINR-E—4-87-581) On the pion-nucleus dynamics at low energies.** Khankhasaev, M.Kh.; Sapozhnikov, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702822/JAW.

Submitted to the journal Phys. Lett. .

The low-energy pion scattering (up to 50 MeV) on ^{12}C and ^{16}O is described quantitatively in the framework of the unitary-approach based on the coupling constant evolution method. It is shown that the differential cross sections of ~ 50 MeV pions arise as a result of a strong interference between the pure potential scattering and absorption channel. The importance of nuclear structure effects in the pion-nucleus dynamics at low energies is discussed. 15 refs.; 2 figs.; 3 tabs.

31630 **Large p/sub T/ from the fragmentation of 1.2-GeVnucleon ^{139}La nuclei.** Brady, F.P.; Christie, W.B.; Romero, J.L.; Tull, C.E.; McEachern, B.; Webb, M.L.; Young, J.C.; Crawford, H.J.; Greiner, D.E.; Lindstrom, P.J.; and others. (Department of Physics and Crocker Nuclear Laboratory, University of California, Davis, California 95616). *Physical Review Letters;* 60: No. 17, 1699-1702(25 Apr 1988).

The first measurements of the transverse momenta (p/sub T/) of heavy projectile fragments produced by fragmentation of 1.2-GeVnucleon La are presented. The momentum distributions of the fragments (Z≃26—56) are Gaussians and broader than predicted by models based on internal momenta of the projectile nucleons. The larger p/sub T/ observed do not appear to be due solely to Coulomb effects, but are consistent with a simple model whereby nucleons from the (hot) overlap region recoil collectively into the (colder) projectile fragments. Thus, p/sub T/ and the fragment mass may provide a good indication of the vector impact parameter b.

31631 **Magnetic structure of ^{17}O at high momentum.** Kalantar-Nayestanaki, N.; Baghaei, H.; Bertozzi, W.; Dixit, S.; Finn, J.M.; Hyde-Wright, C.E.; Kowalski, S.; Lourie, R.W.; Sargent, C.P.; Ulmer, P.E.; and others. (Department of Physics and Laboratory for Nuclear Science, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* 60: No. 17, 1707-1710(25 Apr 1988).

The elastic magnetic form factor of ^{17}O has been measured for effective momentum transfers 2.47≦q/sub e//sub f//sub f/ ≦3.65 fm^{-1} by electron scattering. The form factor drops by almost three decades in this range. The data follow an extreme single-particle Woods-Saxon shell-model calculation. Many-body effects such as meson-exchange currents or core polarization do not seem to play a significant role in the q range of this experiment.

31632 **50 MeV pion inelastic scattering to the 1^+ doublet in ^{12}C.** Ritchie, B.G.;Escalante, J.A.;Adams, G.S.;Al-Solami, M.;Lasheen, N.;Pignault, G.;Preedom, B.M.;Whisnant, C.S.;Mitchell, J.H.;Peterson, R.J. (Department of Physics, Arizona State University, Tempe, Arizona 85287-1504). *Physical Review [Section] C: Nuclear Physics;* 37: No. 3, 1347-1349(Mar 1988).

Cross sections have been measured for the excitation of the 12.71 MeV, T = 0, and 15.11 MeV, T = 1, 1^+ states in ^{12}C by 50 MeV π/sup +- / scattering. The cross section ratio, R = Σ(12.7 MeV)Σ(15.1 MeV), was found to be 7.5 +- 1.5 for π^+ and 6.6 +- 1.5 for π^- at 50 MeV, giving an isospin averaged value of R = 7.05 +- 1.06. These results indicate that the anomalous behavior of R is attributable to the energy dependence of the T = 1 1^+ level. The data also indicate that the impulse approximation is probably invalid at 50 MeV, contrary to the conclusions of a recent study at 65 MeV.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

31633 **(BNL—40838) Transverse energy distributions in Si + nucleus collisions at 10 GeV/nucleon.** Bassalleck, B;Braun-Munzinger, P.;Cleland, W.;David G.;Farooq, A.;Fatyga, M.;Gavron, A.;Greene, V.;Hall, J.;Heifetz, R.;Herman, M.;Kent, H.;Kraus, D.;Lissauer, D.;Llope, W.;Ludlam, T.;Moroz, Z.;O'Brien, E.;Olsen, L.;Sarantites, D.;Semkow, T.;Shivakumar, B.;Simon, J.E.;Stachel, J.;Takai, H.;Throwe, T.;Waters, L.;Wojtkowska, J.;Wolf, K.;Wolfe, D. (Brookhaven National Lab., Upton, NY (USA)). Aug 1987. Contract AC02-76CH00016. 14p. (CONF-8708202—9). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007570/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (24 Aug 1987).

Transverse energy distributions have been measured for collisions of 10 GeVnucleon Si with targets of Al, Cu and Pb using a combination of a NaI wall and a uranium based sampling calorimeter. The measured cross sections dΣdE/sub T/ and dE/sub T/d{eta are consistent with full stopping and an increase, with increasing values of E/sub T/, of energy flow into large angles. 4 refs., 7 figs., 2 tabs.

31634 **Excitation of giant resonances in ^{28}Si with 250 MeV protons.** Lisantti, J.; Bertrand, F.E.; Horen, D.J.; Burks, B.L.; Glover, C.W.; McDaniels, D.K.; Swenson, L.W.; Chen, X.Y.; Haeusser, O.; Hicks, K.; and others. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* 37: No. 6, 2408-2417(Jun 1988).

Differential cross section measurements have been made for 250 MeV proton inelastic scattering from ^{28}Si. Hadronic deformation lengths for the states at 1.78 (2^+), 4.62 (4^+), 6.8 (3^- and 4^+), 9.70 (5^-), and 10.2 MeV (3^-) have been extracted using a first-order vibration model distorted-wave Born approximation description. Deformation lengths for the 2^+ and 4^+ states are found to be independent of proton energy from 40 to 500 MeV. Cross sections for the excitation of the giant resonance region are found to be highly fragmented between 16 to 25 MeV. This region of excitation is found to contain an energy weighted sum rule depletion of 70% for the isovector giant dipole resonance, 26% for the isoscalar giant quadrupole resonance, and 5% for the isoscalar hexadecapole resonance. No structure was observed in the inelastic continuum region of 25 to 45 MeV of excitation energy.

31635 **First observation of the (^6Li,^8He) reaction.** Gagliardi, C.A.; Semon, D.R.; Takada, E.; Tanner, D.M.; Tribble, R.E. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). *Physical Review [Section] C: Nuclear Physics;* 37: No. 6, 2889-2891(Jun 1988).

We have measured the cross section of the $^{27}Al(^6Li,^8He)^{25}Si$ reaction. At a scattering angle of 5.5° and a beam energy of 92.5 MeV, we find the laboratory cross section to populate the ^{25}Si ground state doublet to be 3.6 +- 1.0 nbsr and the cross section to populate the 0.82 MeV second excited state to be ≃200 pbsr. We also measured the (^6Li,^8He) reaction for ^{64}Zn and ^{24}Mg targets. We find yields of ≃250 pbsr and <300 pbsr, respectively. This experiment represents the first observation of the (^6Li,^8He) exotic nuclear reaction.

31636 **Abnormally large momentum loss in charge pickup by 900-MeV/nucleon Au nuclei.** Gerbier, G.; Ren Guoxiao; Price, P.B. (Physics Department, University of California, Berkeley, California 94720). *Physical Review Letters;* 60: No. 22, 2258-2261(30 May 1988).

Using a thin stack of glass detectors to measure $Z\beta$ of forward-projected fast fragments from interactions of 900-MeVnucleon ^{197}Au nuclei, we measure a cross section of 35 +- 8 mb for charge pickup (ΔZ = +1) from Au to Hg, and we infer a mean velocity downshift $\delta\beta$≃-0.004 and a mean momentum downshift δrho/sub parallel/≃-6 GeVc for Au to Hg, 2 orders of magnitude

larger than observed for charge pickup by light nuclei. Implications of this result are discussed.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

31637 (CONF-871243—6) Energy dependence of complete and incomplete fusion for mass 56 entrance channel systems at E/sub lab/ > 10 MeVnucleon. Kovar, D.G.;Beck, C.;Vineyard, M.F.;Janssens, R.V.F.;Sanders, S.J.;Stephans, G.S.F.;Wilkins, B.D.;Henderson, D.J.;Hinnefeld, J.D.;Kolata, J.J.;Maguire, C.F.;Prosser, F.W.;Rosner, G. (Argonne National Lab., IL (USA); Notre Dame Univ., IN (USA); Vanderbilt Univ., Nashville, TN (USA); Kansas Univ., Lawrence (USA); Technische Univ. Muenchen (Germany, F.R.)). [1987]. Contract W-31109-ENG-38. 8p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88005978/JAW.

From Symposium on hot nuclei; College Station, TX, USA (7 Dec 1987).

Three entrance channels $^{16}O + {}^{40}Ca$, $^{28}Si + {}^{28}Si$, and $^{32}S + {}^{24}Mg$ forming the ^{56}Ni compound nucleus have been studied in the energy range 5 to 17 MeVnucleon. Time-of-flight measurements provided mass identification and allowed for extraction of velocity distributions. These distributions were used to identify evaporation residues and to decompose the evaporation residues yeilds into complete and incomplete fusion components using evaporation code calculations. The velocity centroids as function of angle and mass are found to put constraints on the possible pre-equilibrium emission of light particles. 16 refs., 6 figs.

31638 (DOE/ER/40162—T3) Light particle emission measurements in heavy ion reactions: Progress report, June 1, 1987-May 31, 1988. Petitt, G.A. (Georgia State Univ., Atlanta (USA). Dept. of Physics and Astronomy). 1988. Contract FG05-84ER40162. 24p.

This paper discusses work on heavy ion reactions done at Georgia State University. Topics and experiments discussed are: energy division in damped reactions between ^{58}Ni projectiles and ^{165}Ho and ^{58}Ni targets using time-of-flight methods; particle-particle correlations; and development works on the Hili detector system. 10 refs., 9 figs. (DWL)

31639 Tests of the exponential decay law at short and long times. Norman, E.B.; Gazes, S.B.; Crane, S.G.; Bennett, D.A. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 22, 2246-2249(30 May 1988).

We have studied the β decays of ^{60}Co at times approx. $<10^{-4}t_{1/2}$ and those of ^{56}Mn over the interval $0.3t_{1/2} \leqq t \leqq 45t_{1/2}$ to search for proposed deviations from the exponential decay law at short and long times, respectively. Over all time periods examined, our data are consistent with purely exponential behavior. From these measurements, stringent limits are derived on the amplitudes of possible deviations from the exponential decay law.

31640 /sup 52,54/Cr(p,n)/sup 52,54/Mn and /sup 57,58/Fe(p,n)/sup 57,58/Co reactions at E/sub p/ = 120 MeV. Wang, D.; Rapaport, J.; Horen, D.J.; Brown, B.A.; Gaarde, C.; Goodman, C.D.; Sugarbaker, E.; Taddeucci, T.N. (Ohio Univ., Athens (USA); Oak Ridge National Lab., TN (USA); Michigan State Univ., East Lansing (USA); Niels Bohr Inst., Copenhagen (Denmark); Indiana Univ., Bloomington (USA); Ohio State Univ., Columbus (USA); Los Alamos National Lab., NM (USA)). *Nuclear Physics [Section] A;* **480**: No. 2, 285-311(4 Apr 1988).

Differential cross sections for the (p,n) reaction on /sup 52,54/Cr and /sup 57,58/Fe have been measured for angles up to θ/sub lab/ = 10.5° and 14.6°, respectively, using 120 MeV protons. The observed angular distributions are used to evaluate the location and strength of Gamow-Teller resonances. A shell-model calculation of this strength distribution is presented and compared with the experimental results. The M1 strength for ^{52}Cr is also calculated and compared with available results from (e,e') and (p,p') experiments. A comparison is made with other $1f_{7/2}$ nuclei.

31641 Using the (p-arrow-right,p-arrow-right ') reaction to study ΔS = 0 giant resonances. Baker, F.T.;Bimbot, L.;Fergerson, R.W.;Glashausser, C.;Jones, K.;Green, A.;Nakayama, K.;Nanda, S. (University of Georgia, Athens, Georgia 30602). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1350-1353(Mar 1988).

Measurements of spin-flip probabilities for inelastic scattering of 318 MeV protons from ^{40}Ca reveal that much of the background underlying the giant dipole and quadrupole resonances at small angles is from ΔS = 1 transitions. This holds the promise of allowing a much better estimate of this background than has previously been possible;one model-dependent parameter is necessary. Subsequent analysis with a first estimate of this parameter is presented.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

31642 Decay of ^{87}Y. Alburger, D.E.;Warburton, E.K.;Becker, J.A. (Brookhaven National Lab., Upton, NY (USA);Lawrence Livermore National Lab., CA (USA)). *Journal of Physics F (London). Metal Physics (London);* **14**: No. 2, 229-237(Feb 1988).

The energies and intensities of γ rays from the decay of ^{87}Y(tsub(12) = 79.8h), produced in the ^{87}Sr(p, n) reaction at Esub(p) = 18 MeV, were measured with a Ge(Li) detector. Precision energy values of 388.531(3) and 484.805(5) keV were determined for the two ^{87}Y γ rays using the mixed source technique. The intensity ratio of the 485 and 389 keV γ rays was measured to be 1.0875(45). This ratio was used to derive log ft values for the decay of ^{87}Y to the 389 and 873 keV levels of ^{87}Sr. The results are compared with predictions of a shell-model calculation which assumes ^{56}Ni as an inert core. The Sr + p bombardment also produced radioactive ^{83}Rb and ^{85}Sr. Measurements via the mixed source technique resulted in the following γ-ray energies: ^{85}Sr, 514.005(4) keV;^{83}Rb, 520.389(12), 529.591(13) and 552.588(20) keV.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

31643 (JINR-R—3-87-568) Investigation of partial cross sections of (n,α) reactions on ^{143}Nd, ^{147}Sm and ^{149}Sm by technique of filtered neutron beams. Andrzejewski, J.; Vo Kim Thanh; Vtyurin, V.A.; Popov, Yu.P.; Vertebnyj, V.P.; Kirilyuk, A.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics; AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702825/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

The average partial cross sections of the (n, α)-reaction on ^{143}Nd, ^{147}Sm and ^{149}Sm at a neutron energy of 2.2, 24.5 and 144 keV achieved by using the interference filters were measured. The dependence of the strength function for α-particles on neutron energy, energy of the α-particle and atomic weight of the above mentioned nuclei was studied. The results obtained are in accordance with the assumptions of the statistical theory. No depenence of the strength function on energy of excitation was found. For the ^{147}Sm nucleus target a possibility of a week enhancement of α-transitions to the 2^+ state as compared with that to 0^+ was observed. 15 refs.; 8 figs.; 4 tabs.

31644 Mechanisms for light charged particle emission in the reactions 247 and 337 MeV ^{40}Ar+/sup nat/Ag. Lacey, R.; Ajitanand, N.N.; Alexander, J.M.; de Castro Rizzo, D.M.; Peaslee, G.F.; Vaz, L.C.; Kaplan, M.; Kildir, M.; La Rana, G.; Moses, D.J.; and others. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 6, 2540-2560(Jun 1988).

Light charged particles from the reactions 247 and 337 MeV ^{40}Ar+/sup nat/Ag have been measured in singles and in coincidence with fission-like products. Most of the ^{1}H and ^{4}He in coincidence with fusion-fission and quasifission can be accounted for by

evaporation from the composite nucleus or by the fragments. Multiplicities are determined for ^{1}H and ^{4}He in association with evaporation residues, fusion-fission, and quasifission. The probability for composite nucleus emission decreases with increasing spin zone of the emitter and gives a view of the role of emitter lifetime. The ratio of composite-nucleus multiplicities for quasifissionfusion-fission is about 12 ((14) for 337 MeV ^{40}Ar (247 MeV ^{40}Ar) which implies a similar ratio for the lifetimes of the respective composite nuclei between thermalization and scission. Energy spectra and angular distributions of particles (in coincidence with fusion-fission and quasifission) are consistent with emission from a strongly distorted nuclear system en route toward scission. Prethermalization emission of ^{4}He is observed at 10^{0} in comparable amounts for peripheral collisions (quasifission and fusion-fission) and for central collisions.

31645 **Decay of ^{101}Sr and the rotational structure of ^{101}Y.** Petry, R.F.; Goulden, J.D.; Wohn, F.K.; Hill, J.C.; Gill, R.L.; Piotrowski, A. (University of Oklahoma, Norman, Oklahoma 73019). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2704-2721(Jun 1988).

The level structure of ^{101}Y has been studied through the β decay of ^{101}Sr. Ninety-six γ rays are placed in a level scheme with 34 levels. The first 14 levels of ^{101}Y (below 1.1 MeV) are identified as members of the four rotational bands associated with the Nilsson orbitals (with bandhead energies in keV) (52[422] (0), (32[301] (510), (52[303] (666), and 12[301] (890). Above 1.2 MeV occur six low-spin (I≦(72) levels that have features expected for members of 12[431] and (32[431] bands, but it is not possible to make unambiguous assignments of all six levels to these two bands. The level energies and γ-decay patterns (both intraband and interband) are well reproduced by simple particle-rotor calculations consisting of single quasiparticles coupled to an axially symmetric core. As is the case for ^{99}Y, the rotational structure of ^{101}Y indicates an axially symmetric deformation ϵ near the middle of the range of $0.3<\epsilon<0.4$. Similarities and differences between the bands observed in ^{99}Y and ^{101}Y are discussed and compared to model predictions.

31646 **Gamma-ray energy correlations from nuclei at very high spins.** Stephens, F.S.; Draper, J.E.; Bacelar, J.C.; Beck, E.M.; Deleplanque, M.A.; Diamond, R.M. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2927-2930(Jun 1988).

We have studied the correlation between (unresolved) γ-ray energies emitted by nuclei at very high spins. This correlation manifests itself (in part) as a reduced probability of finding two γ rays of the same energy and we have measured the detailed shape of this reduced probability distribution. The data can be explained by a superposition of γ rays coming from a high-temperature region where the rotational motion is heavily damped and a low-temperature region where there is little or no damping.

31647 **Search for motional narrowing effects in nuclear γ-ray spectra.** Stephens, F.S.; Draper, J.E.; Deleplanque, M.A.; Diamond, R.M.; Macchiavelli, A.O. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 21, 2129-2132(23 May 1988). Contract AC03-76SF00098.

At moderate temperatures in nuclei (≈0.5 MeV), there is evidence for damping effects in the rotational behavior. Instead of normal rotational bands, each state can emit any one of a distribution of γ-ray energies whose FWHM is called the damping width. At higher temperatures, there are expected to be motional narrowing effects, where the damping widths decrease with further increases in temperature. We do not find such a narrowing in the experimental damping widths.

31648 **Energy dependence of proton-induced xenon fragmentation and the approach to liquid-gas criticality in nuclear matter.** Mahi, M.; Bujak, A.T.; Carmony, D.D.; Chung, Y.H.; Gutay, L.J.; Hirsch, A.S.; Paderewski, G.L.; Porile, N.T.; Sangster, T.C.; Scharenberg, R.P.; and others. (Department of Physics and Department of Chemistry, Purdue University, West Lafayette, Indiana 47907). *Physical Review Letters;* **60**: No. 19, 1936-1939(9 May 1988).

Cross sections ascribed to a multifragmentation process have been obtained from the measured fragment yields (3≦Z/sub f/≦14) in proton-xenon interactions (1≦E/sub p/≦20 GeV). The variation of the yields with both mass and bombarding energy can be understood by use of the droplet model of the liquid-gas phase transition. With increasing energy, this model indicates that multifragmentation occurs first in the mechanical-instability region, next in the supersaturated vapor, and fianally in the critical region.

31649 **Superdeformed band in ^{148}Gd: A test of shell effects in the mass-150 region.** Deleplanque, M.A.; Beausang, C.; Burde, J.; Diamond, R.M.; Draper, J.E.; Duyar, C.; Macchiavelli, A.O.; McDonald, R.J.; Stephens, F.S. (Lawrence Berkeley Laboratory, Nuclear Science Division, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 16, 1626-1629(18 Apr 1988). Contract AC03-76SF00098.

A discrete superdeformed band was found in ^{148}Gd, and was produced both in Ca- and Si-induced compound-nucleus reactions. It is the third band found in the mass-150 region and its properties provide the clearest indication that ^{153}Dy is a "magic" superdeformed nucleus.

31650 **Beta decay properties of ^{148}Er and ^{148}Ho.** Toth, K.S.;Sousa, D.C.;Nitschke, J.M.;Wilmarth, P.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1196-1202(Mar 1988). Contract AC05-84OR21400.

The decay properties of ^{148}Er and ^{148}Ho, produced in ^{58}Ni bombardments of ^{94}Mo, were investigated following on-line mass separation. New γ rays were observed for both nuclides. Transitions assigned to ^{148}Ho decay are predominantly from the decay of the high-spin isomer;based on its decay characteristics, we propose that this state in ^{148}Ho has a spin assignment of 6^{-}. The decay pattern of ^{148}Er shows that the J/sup π/ of the ^{148}Ho low-spin isomer is 1^{+}. Coincidences between protons and x and γ rays establish ^{148}Er and ^{148}Ho to be β-delayed-proton precursors. In the β decay of ^{148}Dy, three weak γ rays were observed in addition to the one intense 620.2-keV transition that has been known to follow the nuclide's decay.

31651 **Decays of ^{118}In, ^{120}In isomers to levels in ^{118}Sn, ^{120}Sn, and ^{122}Sn.** Raman, S.;Walkiewicz, T.A.;Multhauf, L.G.;Tirsell, K.G.;Bonsignori, G.;Allaart, K. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1203-1228(Mar 1988). Contract AC05-84OR21400.

The nuclear excited states of ^{118}Sn, ^{120}Sn, and ^{122}Sn were studied by means of the decays of 4.45-min ^{118}In isomer, 46.2-sec and 47.3-sec ^{120}In isomers, and 10.3-sec and 10.8-sec ^{122}In isomers, respectively. The In activities were produced by the (n,p) reaction with 14-MeV neutrons on enriched samples of ^{118}Sn, ^{120}Sn, and ^{122}Sn. The γ rays, measured with a Ge(Li) detector, were incorporated into separate level schemes, each resulting from the decay of an individual In isomer. The experimental level schemes of ^{118}Sn, ^{120}Sn, and ^{122}Sn were compared with level schemes calculated on the basis of a broken-pair model that includes up to two broken pairs in the 50<N<82 shell. This model is reasonably successful in explaining the experimental data for these nuclides.

31652 **Systematics of g factors in the neutron-rich /sup 142,144,146/Ba isotopes.** Wolf, A.;Gill, R.L.;Mach, H.;Casten, R.F.;Winger, J.A. (Brookhaven National Laboratory, Upton, New York 11973 Nuclear Research Center Negev, Beer Sheva, Israel Clark University, Worcester, Massachusetts 01610 Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1253-1255(Mar 1988). Contract AC02-76CH00016.

The g factor of the 2_1^+ state in ^{142}Ba has been remeasured with higher accuracy. The new result, when combined with recently measured values of $T_1$2 for this state and with g(2_1^+) values in /sup 144,146/Ba, clearly indicates that in this region, the proton-neutron interacting boson model gives a much better description of

magnetic moments than the hydrodynamical model with the Greiner corrections.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

31653 (CONF-880496—1) Alignments, shape changes, band terminations and transition rates in ^{157}Tm. Riley, M.A.; Baktash, C.; Ellis-Akovali, Y.A.; Halbert, M.L.; Hensley, D.C.; Johnson, N.R.; Lee, I.Y.; McGowan, F.K.; Janzen, V.P.; Riedinger, L.L.; Chaturvedi, L. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); Vanderbilt Univ., Nashville, TN (USA)). 1988. Contract AC05-84OR21400. 5p. (CONF-880496—).

From Conference on high-spin nuclear structure and novel nuclear shapes; Argonne, IL, USA (13 Apr 1988).

This paper investigates the preli8minary high spin states of the 157 Tm nucleus. Yrast band, parity feature and transition probabilities are also discussed. 12 refs., 3 figs.

31654 (DOE/ER/40159—130) The structure of nuclei far from beta stability: A progress report for the period May 15, 1987 to May 14, 1988. Zganjar, E.F. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1988. Contract FG05-84ER40159. 38p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006542/JAW.

The research at UNISOR constiues the major effort of our work on far from stability nuclei. The extensive data from the UNISOR studies on the neutron-deficient Tl Hg, Au and Pt isotopes has not only established a new region of nuclear deformation and a new class of nuclear structure at closed shells; but, after full analysis, will ultimately transform our present understanding of shape coexistence. Our experimental approach is to take great care to obtain accurate experimental information and then to take equally great care in its interpretation. We have shown in the study of the odd-A Au isotopes that one can use the odd proton to probe the even-even Pt cores and thus expose the finer details of the coexisting structures in those cores. We have also shown that to utilize such an approach one must systematically track all states below about 1 MeV across isotopic or isotonic sequences; and that to accomplish such a tracking it is necessary to push the spectroscopic measurements to new limits in terms of quality and statistics. The major results of the recent work involve the developemnt of a unified description of intruder states and shape coexistence in nuclei.

31655 (DOE/ER/40346—1) Studies of yrast and continuum states in A = 140-160 nuclei: Progress report for 1987. Daly, P.J. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). Feb 1988. Contract FG02-87ER40346. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007762/JAW.

High-spin nuclear phenomena in the mass region around A-150 have been studied by in-beam γ-ray and electron spectroscopy. Recent results for the nuclei ^{148}Gd, ^{149}Er, ^{153}Dy and ^{154} Dy are summarized. The first in-beam experiments at ATLAS using the Purdue superconducting electron spectrometer are also described. 11 refs., 2 figs.

31656 Large-angle correlations between ^{4}He and /sup 1,2,3/H or ^{4}He in the reactions 247 and 337 MeV ^{40}Ar+/sup nat/Ag: Unexpected properties of the nuclear stratosphere. Lacey, R.; Ajitanand, N.N.; Alexander, J.M.; de Castro Rizzo, D.M.; Peaslee, G.F.; Vaz, L.C.; Kaplan, M.; Kildir, M.; La Rana, G.; Moses, D.J.; and others. (Department of Chemistry, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 6, 2561-2577(Jun 1988).

We have measured coincidences between ^{4}He and /sup 1,2,3/H or a second ^{4}He (large-angle correlations) in the reactions 247 and 337 MeV ^{40}Ar+/sup nat/Ag. These coincidences are dominated by reactions leading to evaporation residues with spins of about 0—70(h2π). Large values of the angle-integrated double and triple coincidence cross sections indicate that many particle evaporation chains involve 2 or 3 protons andor 2 or 3 alphas. The angular and energy distributions are well described by an evaporation model with Hauser-Feshbach coupling. However, one must employ effective evaporation barriers for ^{1}H and ^{4}He that are strongly reduced compared to empirical fusion barriers. The barrier reduction required for ^{2}H is rather small, and for ^{3}H no barrier reduction is needed. Evaporation calculations that include emitter deformation do not give a satisfactory explanation for these results. We suggest a new aspect of composite nucleus excitation and evaporation-like decay. A hot, very diffuse nuclear surface may be formed that promotes evaporative decay prior to its relaxation. The low barriers for ^{1}H and ^{4}He reflect the radial extent of this transitory, diffuse surface.

31657 Nuclear data sheets for A = 159. Lee, M.A. (Idaho National Engineering Laboratory, EG&G Idaho, Inc.). *Nuclear Data Sheets;* **53**: No. 4, 507-600(Apr 1988).

The experimental results from the various reaction and decay studies leading to nuclides in the A = 159 mass chain have been reviewed. These data are summarized and presented, together with the adopted level schemes and properties. copyright 1988 Academic Press, Inc..

31658 Light-particle multiplicity accompanying projectile breakup at 20 MeV/nucleon. Vandenbosch, R.;Connolly, R.C.;Gil, S.;Leach, D.D.;Awes, T.C.;Sorensen, S.;Wu, C.Y. (University of Washington, Seattle, Washington 98195). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1301-1303(Mar 1988).

A large-solid-angle array has been used to determine the multiplicity of Z = 1 and Z = 2 particles accompanying projectile breakup into two fragments each with 5≦Z≦8. The charge balance obtained shows that projectile breakup is not associated with an unusual charge transfer to the target.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

31659 (CERN-EP—86-144) Heavy hypernuclei at LEAR. Epherre-Rey Campagnolle, M. (Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse; European Organization for Nuclear Research, Geneva (Switzerland)). 7 Oct 1986. 11p. (CONF-8608135—3).

From INS international symposium on hypernuclear physics; Tokyo, Japan (20 Aug 1986).

The CERN experiment aimed at measuring the lifetime of heavy hypernuclei produced in the annihilation of antiprotons within ^{238}U and ^{209}Bi nuclei is presented. The experimental method based on the delayed-fission decay of these hypernuclei and the preliminary results already obtained are discussed. 10 refs., 7 figs.

31660 (CONF-870632—14) Transverse and zero degree energies observed in ^{16}O induced nuclear collisions at 60 and 200 A GeV. Gustafsson, H.A.;Albrecht, R.;Awes, T.C.;Baktash, C.;Beckmann, P.;Berger, F.;Bock, R.;Claessen, G.;Dragon, L.;Ferguson, R.L.;Franz, A.;Garpman, S.;Glasow, R.;Gutbrod, H.H.;Johnson, J.W.;Kampert, K.H.;Kolb, B.W.;Kristiansson, P.;Lee, I.Y.;Lohner, H.;Lund, I.;Obenshain, F.E.;Oskarsson, A.;Otterlund, I.;Peitzmann, T.;Persson, S.;Plasil, F.;Poskanzer, A.M.;Purschke, M.;Ritter, H-G;Santo, R.;Schmidt, H.R.;Siemiarczuk, T.;Sorensen, S.P.;Stenlund, E.;Young, G.R. (European Organization for Nuclear Research, Geneva (Switzerland)). 1987. Contract AC05-84OR21400. 4p.

From International Europhysics conference on high energy physics; Uppsala, Sweden (25 Jun 1987).

Results from QCD calculations indicate that a sufficiently high energy densities, nuclear matter may undergo a transition to a phase in which quarks and gluons are deconfined. Nuclear collisions at very high energies are believed to be well suited from producing the conditions required for this phase transition to take place. At the CERN SPS, sufficiently high energy densities can only be reached if the degree of nuclear stopping involved is sufficiently high. Consequently, one of the main goals of the recent experiments with oxygen nuclei is to obtain estimates of the extent of

nuclear stopping and of the resulting energy densities. Such information can be obtained by means of calorimetric measurements of transverse energies and of the energy at zero degrees (+- 0.3{degree}). In this paper we concentrate on the understanding of systematic variation with target size and projectile energy, and of the key role of nuclear geometry. 5 refs., 3 figs.

31661 **(CONF-8708166—3) Neutral transverse momentum spectra in 60 and 200 A{center←dot}GeV ^{16}O + nucleus and proton + nucleus reactions.** Loehner, H.; Albrecht, R.; Awes, T.C.; Baktash, C.; Beckmann, P.; Berger, F.; Bock, R.; Claesson, G.; Dragon, L.; Ferguson, R.L.; Franz, A.; Garpman, S.; Glasow, R.; Gustafsson, H.A.; Gutbrod, H.H.; Kampert, K.H.; Kolb, B.W.; Kristiansson, P.; Lee, I.Y.; Lund, I.; Obenshain, F.E.; Oskarsson, A.; Otterlund, I.; Peitzmann, T.; Persson, S.; Plasil, F.; Poskanzer, A.M.; Purschke, M.; Ritter, H.G.; Santo, R.; Schmidt, H.R.; Siemiarczuk, T.; Sorensen, S.P.; Stenlund, E.; Young, G.R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Lund Univ. (Sweden); Muenster Univ. (Germany, F.R.); Oak Ridge National Lab., TN (USA); Deutsche Forschungsgemeinschaft, Bonn (Germany, F.R.); Swedish Natural Science Research Council, Stockholm; Tennessee Univ., Knoxville (USA); Institute of Nuclear Research, Warsaw (Poland)). 1987. Contract AC05-84OR21400. 12p.

From 6. international conference on ultra-relativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

Transverse momentum (p/sub tau/) distributions of inclusive photons and neutral pions at midrapidity are measured with a lead glass calorimeter in 60 and 200 A{center←dot}GeV ^{16}O + nucleus and proton + nucleus reactions. Inclusive photon distributions are compared for central and peripheral reactions. The degree of centrality is determined either from the charged particle multiplicity or from the remaining projectile energy in th forward direction. Deviations from a nucleus+nucleus interaction model based upon linear extrapolation from p + p reactions are observed in central ^{16}O + Au data. The variation of the average transverse momentum is investigated as function of centrality. The target-mass and energy dependence of π{degree} p/sub tau/ distributions are presented. For ^{16}O + Au a change of slope in these distributions is observed at p/sub tau/ ~ 0.8 GeVc compatible with hydrodynamic expansion models. 20 refs., 8 figs., 3 tabs.

31662 **(CONF-8708202—7) Target fragmentation in proton-nucleus and ^{16}O-nucleus reactions at 60 and 200 GeV-nucleon.** Schmidt, H.R.;Albrecht, R.;Awes, T.C.;Baktash, C.;Beckmann, P.;Claesson, G.;Berger, F.;Bock, R.;Dragon, L.;Ferguson, R.L.;Franz, A.;Garpman, S.;Glasow, R.;Gustafsson, H.A.;Gutbrod, H.H.;Kampert, K.H.;Kolb, B.W.;Kristiansson, P.;Lee, I.Y.;Loehner, H.;Lund, I.;Obenshain, F.E.;Oskarsson, A.;Otterlund, I.;Peitzmann, T.;Persson, S.;Plasil, F.;Poskanzer, A.M.;Purschke, M.;Ritter, H.G.;Santo, R.;Siemiarczuk, T.;Sorensen, S.P.;Stenlund, E.;Young, G.R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Oak Ridge National Lab., TN (USA); Muenster Univ. (Germany, F.R.); Lawrence Berkeley Lab., CA (USA); Lund Univ. (Sweden)). Jan 1987. Contract AC05-84OR21400. 12p. (GSI—88-10). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88006976/JAW.

From Quark matter '87: 6th international conference on ultra-relativistic nucleus-nucleus collisions; Schloss Nordkirchen, F.R. Germany (24 Aug 1987).

Target remnants with Z<3 from proton-nucleus and ^{16}O-nulceus reactions at 60 and 200 GeVnucleon were measured in the angular range from 30{degree} to 160{degree} (-1.7<{eta}1.3) employing the Plastic Ball detector. The excitation energy of the target spectator matter in central oxygen-induced collisions is found to be high enough to allow for complete disintegration of the target nucelus into fragments with Z<3. The average longtitudinal momentum transfer per proton to the target in central collisions is considerably higher in the case of ^{16}O-induced reactions (~300 MeVc) than in proton-induced reactions (~130 MeVc). The baryon rapidity distributions are roughly in agreement with one-fluid hydrodynamical calcualtions at 60 GeVnucleon ^{16}O{plus}Au but are in disagreement at 200 GeVnucleon, indicating the higher degree of transparency at the higher bombarding energy. Both, the transverse moments of target spectators and the entropy produced in the target gfragmentation region are compared to those attained in head-on collisions of two heavy nuclei at Bevalac energies. They are found to be comparable or do even exceed the values for the participant matter at beam energies of about 1-2 GeVnucleon. 18 refs., 112 figs.

31663 **Transition from quasi-elastic to deep-inelastic reactions in the $^{48}Ti+^{208}Pb$ system.** Rehm, K.E.; van den Berg, A.M.; Kolata, J.J.; Kovar, D.G.; Kutschera, W.; Rosner, G.; Stephans, G.S.F.; Yntema, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* 37: No. 6, 2629-2646(Jun 1988).

Transfer reaction cross sections for the systems /sup 46,48,50/Ti+ ^{208}Pb at E/sub c.m./ = 243 MeV have been measured with single mass and charge resolution using a magnetic spectrograph and a gas-filled focal-plane detector. The angle and excitation energy ranges studied in this experiment covered both quasi-elastic and deep-inelastic processes. The total reaction cross sections are dominated by transfer reactions with neutron transfer being the strongest transfer mode. Wilczyn-acute-accentaki plots for individual reaction channels have been generated showing a gradual transition from quasi-elastic reactions to deep-inelastic processes. While macroscopic models cannot explain the element distributions observed in this experiment, a simple model based on a random walk in the N-Z plane gives good agreement for the reaction strength and the measured energy spectra.

31664 **Electromagnetic dissociation for high-Z projectiles and at ultrarelativistic energies.** Hill, J.C.;Wohn, F.K.;Winger, J.A.;Smith, A.R. (Ames Laboratory and Iowa State University, Ames, Iowa 50011). *Physical Review Letters;* 60: No. 11, 999-1001(14 Mar 1988). Contract W-7405-ENG-82.

Experiments to determine the characteristics of electromagnetic dissociation (ED) has been extended to high projectile charge and ultrarelativistic energies using ^{139}La and ^{16}O projectiles on ^{197}Au targets. The gross features are reproduced in a Weizsaecker-Williams calculation but significant systematic deviations appear. The results are used as a guide in extending the calculations to the regime of energies and projectiles expected for planned heavy-ion colliders where Ed effects should comprise a major fraction of the total cross section.

31665 **Unusual backward emission of multifragmentation products in ultrarelativistic nucleus-nucleus collisions.** Loveland, W.;Aleklett, K.;Bronikowski, M.;Chu, Y.Y.;Cumming, J.B.;Haustein, P.E.;Katcoff, S.;Porile, N.T.;Sihver, L. (Department of Chemistry, Oregon State University, Corvallis, Oregon 97331 Studsvik Neutron Research Laboratory, S-61182 Nykoping, Sweden Department of Chemistry, Purdue University, West Lafayette, Indiana 47907 Department of Chemistry, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* 37: No. 3, 1311-1313(Mar 1988). Contract AM06-70RL02227.

Light fragments such as ^{24}Na resulting from the multifragmentation of Au by 232-GeV ^{16}O are emitted preferentially backwards in the laboratory system (FB = 0.81 +- 0.05). This effect is not seen for similar products from V, Cu, or Ag targets, or for fission products from Au.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

31666 **(CONF-880601—6) R-matrix analysis of the ^{235}U neutron cross sections.** Leal, L.C.; de Saussure, G.; Perez, R.B. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88004479/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

The ENDFB-V representation of the ^{235}U neutron cross sections in the resolved resonance region is unsatisfactory: below 1 eV

the cross sections are given by "smooth files" (file 3) rather than by resonance parameters; above 1 eV the single-level formalism used by ENDFB-V necessitates a structured file 3 contribution consisting of more than 1300 energy points; furthermore, information on level-spins has not been included. Indeed the ENDFB-V ^{235}U resonance region is based on an analysis done in 1970 for ENDFB-III and therefore does not include the results of high quality measurements done in the past 18 years. The present paper presents the result of an R-matrix multilevel analysis of recent measurements as well as older data. The analysis also extends the resolved resonance region from its ENDFB-V upper limit of 81 eV to 110 eV. 13 refs., 2 figs., 1 tab.

31667 (NEANDC(J)—124/U) Gamma-ray spectrum data library of fission product nuclides and its assessment. Katakura, Jun-ichi; Yoshida, Tadashi. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Japanese Nuclear Data Committee). Mar 1988. 165p. (JAERI—1311; INDC(JPN)—110/L). Japan Atomic Energy Research Institute, Tokai-mura, Naka-gun, Ibaraki-ken, Japan; GPO Dep. Order Number TI88900624/JAW.

A gamma-ray spectrum data library of fission product nuclides was prepared on the same basis as the JNDC library which is used for the decay heat prediction. The gamma-ray spectrum data were compiled with both measured and theoretically estimated spectra. For nuclides with no or insufficient gamma-ray transition data, the estimated spectra were applied to compensate the defect of the measured data. By introducing the estimated spectra, it becomes possible to calculate the gamma-ray spectra which are consistent with integral decay heat predictions by the JNDC library. By using the spectrum data library, calculations of gamma-ray spectra from aggregate fission product nuclides were carried out. The calculated spectra were compared with the measured ones performed at Oak Ridge National Laboratory and the University of Tokyo. The spectrum calculations showed reasonable agreement with the measured data for a wide range of cooling time. 18 refs., 11 tabs., 245 figs.

31668 Level structure of the doubly-odd ^{242}Am nucleus. Salicio, J.; Drissi, S.; Gasser, M.; Kern, J.; Boerner, H.G.; Colvin, G.G.; Schreckenbach, K.; Hoff, R.W.; Lougheed, R.W. (Physics Department, University of Fribourg, CH-1700 Fribourg, Switzerland). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2371-2390(Jun 1988).

The level structure of the doubly-odd ^{242}Am nucleus was investigated by means of thermal-neutron-capture gamma-ray and conversion electron spectroscopy. Pair, curved-crystal, and β spectrometers were used. The data from these measurements, combined with previous direct reaction results, permit us to establish a detailed level scheme including six new well-developed bands. Our experimental results are interpreted in the framework of the Nilsson model. Precise Gallagher-Moszkowski splittings and Newby odd-even shifts extracted from the data are compared with theoretical calculations.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 31412, 31436, 31530, 31538, 31541, 31613, 31619, 31622, 31622, 31622, 31623, 31637, 31658, 31667, 31812, 32011

31669 (AD-A—189238/9/XAB) Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser. Quarterly technical progress report, 1 July-30 September 1987. Collins, C.B. (Texas Univ., Richardson (USA). Center for Quantum Electronics and Applications). Oct 1987. 113p. (UTD-GRL—8702). NTIS, PC A06/MF A01.

Recent approaches to the problem of the gamma ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long-wavelength radiation. At the nuclear level the storage of energy can approach tera-Joules per liter for thousands of years. Any plan to use such a resource for a gamma-ray laser poses problems requiring the fusion of concepts taken from relatively unrelated fields of physics. An approach has been pursued for the upconversion of longer-wavelength radiation incident upon isomeric nuclear populations that can avoid many of the difficulties encountered with traditional concepts of single-photon pumping. The present state-of-the-art has been adequate to identity 29 first-class candidate materials, but further evaluation precision. This report focuses upon continued development of one of the new technologies being developed for the screening of the laser candidates. It is the nuclear analog of the optical double-resonance methods which produced much of the database at the molecular level that was such essential use in the development of conventional lasers. Applied most recently to the study of levels which might be used in dumping isomeric populations into freely radiating states, it produced an unexpected result of major importance. In several test isotopes, a class of extremely useful states was discovered that could radiatively couple to both normal and isomeric states of a nucleus.

31670 (CEA-N—2540) Heavy ion seeks phase transition. Ducomet, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 91 (France)). Nov 1987. 77p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88753058/JAW.

The emergence of the phase transition language in the context of heavy ion collisions at the so called "GANIL energies" (typically 10 - 100 MeV/u) has led us to make more precise some current definitions adopted in statistical mechanics, and used in a much less clear way in the nuclear physics context.

31671 (CERN-EP—86-191) Hyperfine structure and isotope shift investigation in $^{202-222}Rn$ for the study of nuclear structure beyond Z = 82. Borchers, W.; Neugart, R.; Otten, E.W.; Duong, H.T.; Ulm, G.; Wendt, K. (Mainz Univ. (Germany, F.R.). Inst. fuer Physik; European Organization for Nuclear Research, Geneva (Switzerland)). 18 Nov 1986. 5p. (CONF-860918—4).

From 7. international conference on hyperfine interactions; Bangalore, India (8 Sep 1986).

The hyperfine structure (hfs) and isotope shift (IS) in the isotopic chain of the radioactive element radon have been studied for the first time. The measurements were carried out by collinear fast-beam laser spectroscopy at the mass separator facility ISOLDE at CERN. The IS between 16 isotopes in the mass range $202 \leqq A \leqq 222$ and the hfs of 7 odd-A isotopes were determined in the transitions $7s[32]_2$ {minus} $7p[52]_3$ (745 nm) of Rn I.The nuclear spins and moments, as well as the observed inversion of the odd-even staggering for $^{201-222}Rn$, can be associated with the effects of octupole instabilite around N {equals} 134.

31672 (CSIR-TWISK-TR—497) Role of the ω meson in topological chiral solitons. Quick, R.M.; Miller, H.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Oct 1986. 17p. National Research Institute for Mathematical Sciences, CSIR, P O Box 395, Pretoria, 0001, South Africa.

We consider the chiral bag model recently proposed in which an exterior Skyrme soliton interacts with the interior quarks through the imposition of the continuity of the axial vector current at the surface. We propose the introduction of the ω meson to enforce, in addition, continuity of the angular average of the baryon density. We obtain unique values of g/sub πNN/, the bag radius, the nucleon-Δ mass, and the isoscalar radius which reproduce the experimental data to within about 20% with the exception of the isoscalar radius.

31673 (CSIR-TWISK-TR—502) Baryon density in a chiral soliton model. Quick, R.M.; Miller, H.G. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Research Inst. for Mathematical Sciences). Dec 1986. 15p. National Research Institute for Mathematical Sciences, CSIR, P O Box 395, Pretoria, 0001, South Africa.

Continuity of the baryon density is introduced into a hybrid chiral soliton model. For a given value of the bag radius, unique predictions of the M-Δ average mass, g/sub A/, the isoscalar radius, and the coupling constant of the Skyrme term are obtained.

31674 (DOE/ER/40335—2) [Theoretical nuclear physics]: Technical progress report, October 1, 1986-October 1, 1987. Kunz, P.D. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). 1 Oct 1987. Contract FG02-87ER40335. 18p. (NPL—1028).

This paper discusses the current research being carried out at the University of Colorado in Nuclear Physics. This research consist of the following topics; Dirac-Hartree for closed-shell {plus}{minus} nuclei, construction of Dirac-Hartree Green Functions, isovector currents in relativisitic models of nuclear structure, contact terms in the parametrization of NN amplitudes, the D{plus}D El capture reaction, and a new model for NN annihilation.

31675 (IC—87/274) Pion condensation in symmetric nuclear matter. Kabir, K.; Saha, S.; Nath, L.M. (Dacca Univ. (Bangladesh). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702678/JAW.

Using a model which is based essentially on the chiral SU(2)xSU(2) symmetry of the pion-nucleon interaction, we examine the possibility of pion condensation in symmetric nucleon matter. We find that the pion condensation is not likely to occur in symmetric nuclear matter for any finite value of the nuclear density. Consequently, no critical opalescence phenomenon is expected to be seen in the pion-nucleus interaction. (author). 20 refs.

31676 (IC—87/328) Intra- and inter-nucleus variations of g factors in Os isotopes. Ansari, A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702721/JAW.

Using a pairing + quadrupole model Hamiltonian suitable for the Os-Pt region we are able to understand simultaneously the experimentally observed mass number and intra-nucleus spin dependent g factor variations for the low lying yrast states of A=186 to 192 osmium isotopes in a microscopic cranked Hartree-Fock-Bogolyubov theory. In a nucleus the initial increase of the g factor with the increase of spin is caused by a small rotation alignment of the $h_{11}2$ proton orbitals. For 1 > or approx. 8 we predict a decrease of g factors due to the alignment of $i_{13}2$ neutrons. (author). 30 refs, 2 figs, 1 tab.

31677 (IC—87/338) Structure of Os - Pt nuclei and g factors of $^{186-192}$Os isotopes at low spins. Ansari, A. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702729/JAW.

Employing a pairing + quadrupole model interaction, especially suitable for the Os - Pt region, the ground state structure of these nuclei is investigated following a selfconsistent Hartree-Fock-Bogolyubov (HFB) approach. Effects of the inclusion of hexadecapole degrees of freedom in the Hamiltonian are also studied. All the osmium isotopes considered here come out to be prolate in shape in the ground state. ^{186}Pt is triaxial with $\gamma=12$ deg. and with the increasing mass number they gradually go over to the oblate shape at A=190 itself. In view of recent experimental data on g factors of osmium isotopes which show interesting variations as a function of mass number as well as spin, we have calculated these following the methods of variation after exact angular momentum projection of axial HFB wave functions and the cranked HFB theory. The observed trend of the variation of g factor at I=2 with the mass number is reproduced with very minor adjustments of the force constants of the Hamiltonian in both the approaches. However, the variation of g factor with spin, which is sensitive to the interplay between collective and the single particle degrees of freedom, can be understood only in the cranking approach. (author). 52 refs, 8 figs, 6 tabs.

31678 (IFUSP-P—629) Sum rule approach to the study of statistical decay properties of nuclear giant resonances. Adhikari, S.K.; Hussein, M.S. (Pernambuco Univ., Recife (Brazil). Dept. de Fisica). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Mar 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702746/JAW.

Corrections to the well-known statistical sum rule that relates the summed transmission coefficients on the one hand and 2$\pi\Gamma$/sub C.N./.rho/sub C.N./ On the other, in the context of the statistical decay properties of nuclear giant resonances, are discussed. These corrections arise both from pre-equilibrium processes as well as from the giant resonance itself. It is shown that the compound nucleus average width is reduced as a result of these corrections.

31679 (INFN-LNF—86-32-(P)) Scissors mode. Palumbo, F. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1986. 25p. (CONF-8609219—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702275/JAW.

From Brasov international summer school: symmetrics and semiclassical features of nuclear dynamics; Poiana Brasov, Romania (1 Sep 1986).

A dipole magnetic resonance has been predicted in deformed nuclei by a two-rotor model, as a state in which the nucleus rotates while the proton neutron symmetry axes stay a fixed angle in a scissors-like configuration. This resonance has been also predicted in the VPM and in the IBA, and has been experimentally confirmed by high resolution electron scattering in three regions of the periodic table, i.e. the deformed rare earth nuclei, the $f_7$2-shell nuclei /sup 46,48/Ti and the actinides. The theoretical description is reported in terms of the two-rotor model and the RPA, and a survey of the experimental status is given. 29 refs.

31680 (INIS-mf—11723) Suppression of the neutrinoless $\beta\beta$ decay?. Tomoda, T.; Faessler, A. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1988. 15p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753559/JAW.

The neutrinoless $\beta\beta$ decay rates of ^{76}Ge, ^{82}Se, /sup 128,130/Te are calculated in the quasi-particle random phase approximation using a realistic effective NN interaction. The reduction of the $0\nu\beta\beta$ decay nuclear matrix elements due to ground state correlations is much weaker than that of the $2\nu\beta\beta$ decay matrix elements, and we can deduce stringent limits on the Majorana neutrino mass and the right-handed leptonic currents from experimental data on $0\nu\beta\beta$ decay.

31681 (INIS-mf—11724) Suppression of the βi-decays of ^{148}Dy, ^{150}Er and ^{152}Yb. Suhonen, H.; Faessler, A.; Taigel, T.; Tomoda, T. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753560/JAW.

We use the Quasi-particle Random-phase Approximation (QRPA) with a realistic effective nucleon-nucleon interaction to describe the positron β^+-decay of the neutron-deficient single-closed-shell nuclei $_{66}{}^{148}$Dy$_{82}$, $_{68}{}^{150}$Er$_{82}$ and $_{70}{}^{152}$Yb$_{82}$. In this framework we study the effect of the particle-particle interaction strength on the β^+-transition strengths in these nuclei. We are able to reproduce the experimental strengths by reasonable values of the interaction parameters, not very different from nucleus to nucleus.

31682 (INIS-mf—11725) Suppression of the two-neutrino double β decay. Civitarese, O.; Faessler, A.; Tomoda, T. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1988. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753561/JAW.

Two-neutrino $\beta\beta$ decay rates of ^{76}Ge, ^{82}Se, /sup 128,130/Te are calculated in the quasi-particle random phase approximation using a realistic effective NN interaction. The decays are strongly suppressed, in agreement with the experimental data, when a reasonable amount of particle-particle interaction is taken into account.

31683 (INIS-mf—11726) Possible test of grand unification in the double beta-decay. Faessler, A. (Tuebingen Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). 1988. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753562/JAW.

The more successful grand unified theories predict that the neutrino is identical with its antiparticle and therefore is a Majorana neutrino which violates lepton number conservation. Such a neutri-

no should have a finite mass and also a small right handed weak interaction. If the double neutrinoless beta decay is observed with the full decay energy in the two electrons, it would establish that the electron neutrino is a Majorana particle. It is shown that the relativistic corrections of the nucleonic wave functions are essential for determining an upper limit of the right handedness from the measured lower limit of the life-time against the neutrinoless double beta decay. The upper limit for the right handedness of the weak interaction derived from the lower limit of the life-times against the neutrinoless beta decay is vertical stroke <eta> vertical stroke < 1.8×10^{-8} and the upper limit for the neutrino mass is vertical stroke<m/sub ν/ m>vertical stroke < 1.9[eV]. To test the nuclear structure part of the theory the double beta decay with two neutrinos is calculated and compared with the known experimental values. It is shown that it is important to take into account in the intermediate nucleus not only the particle-hole, but also the particle-particle interaction which acts distructively and reduces the double beta decay with two neutrinos by about a factor 1100 and one obtains a reasonable agreement with the experimental measured data. Applying the same improved description to the β^+-decay in proton rich nuclei, one can explain the long standing puzzle of the quenching of the Gamow-Teller strength in agreement with the data.

31684 **(ITP—86-125) On inelastic form factor of 0^+-resonance in ^{4}He.** Vasilevskiij, V.S.; Rybkin, I.Yu. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702817/JAW.

The form factor of inelastic electron scattering accompanied by the excitation of O^+-resonance ^{4}He is analysed theoretically. The studies are carried out in the collective and cluster models with the Volkov nucleon-nucleon potential. The cluster model, in contrast to the collective one, is shown to reproduce well the experimental form factor dependence on the transfer momentum. This confirms the conclusion on the cluster nature of O^+-resonance. 20 refs.; 2 figs.

31685 **(ITP—87-1) Zero mode contribution in the Skyrme model.** Fujii, K.; Kobushkin, A.P. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702819/JAW.

An approach where the Skyrme-model Lagrangian is initially considered quantum-mechanically is proposed. The new term in the Hamiltonian associated with zero mode contribution is obtained. It is shown that this term can be crucial in stabilization the rotated (quantum) chiral skyrmion. 8 refs.

31686 **(JINR-R—4-87-143) Increase of subbarrier fusion of compound nuclei due to dynamic changes of interaction potential in a reaction input channel.** Dzholos, R.V.; Permyakov, V.P.; Nasirov, A.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702826/JAW.

Submitted to the Organizing Comittee of the 37. All-Union conference on nuclear spectroscopy and nuclear structure, Yurmala, 14-16 Apr 1987; and to the journal Izv. AN SSSR, Ser. Fiz. .

Increase of the channel of subbarrier complex-nucleus fusion is interpreted as a consequence of dynamic changes of the nucleus-nuclear interaction potential in a reaction input channel. It is shown that if the exchange of nucleons between nuclei is taken into account, the potential barrier to the left from its top gets more deep and falls more rapidly. Taking account of collective excitations in nuclei induced by the Coulomb excitation makes the potential barrier more narrow to the right from its top. 22 refs.; 5 figs.

31687 **(JINR-R—4-87-540) Analysis of the ^{48}Ca(p,n)^{48}Sc reaction at intermediate energies and the structure of charge-exchange nuclear excitations.** Gareev, F.A.; Ershov, S.N.; Pyatov, N.I.; Fayans, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702828/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Analysis of the ^{48}Ca(p, n)^{48}Sc reaction at proton energies E/sub p/=134 MeV and 160 MeV was made in microscopic approach connecting distorted wave impulse approximation with structure information on charge-exchange excitations obtained in the theory of finite-fermi systems. Angular distributions, analysing power for the $(\pi f_{7}2, \nu f_{7}2^{-1})$ multiplet of states with J/sup π/=0^+-7^+, and inclusive neutron spectra and polarization transfer coefficients at small angles within the 0 $\leqq$ -Q/sub pn/ $\leqq$ 40 MeV range have been calculated. At -Q/sub pn/ $\geqq$ 20 MeV the calculated cross sections were systematically lower than the experimental ones. That might be due to increasing role of multistep process with increasing excitation energy. Connection of polarization transfer coefficient distributions with the characteristics of excited resonances is discussed. 19 refs.; 7 figs.; 2 tabs.

31688 **(LA-UR—88-376) Recent results in the development of a global medium-energy nucleon-nucleus optical-model potential.** Madland, D.G. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 15p. (CONF-880232—4).

From Nuclear Energy Agency Nuclear Data Committee (NEANDC) specialists' meeting on preequilibrium nuclear reactions; Semmerling, Austria (10 Feb 1988).

Initial results are presented for the determination of a global medium-energy nucleon-nucleus phenomenological optical-model potential using a relativistic Schroedinger representation. The starting point for this work is the global phenomenological optical-model potential of Schwandt {ital et al.}, which is based on measured elastic scattering cross sections and analyzing power for polarized protons ranging from 80 to 180 MeV. This potential is optimally modified to reproduce experimental proton reaction cross sections as a function of energy, while allowing only minimal deterioration in the fits to the elastic cross sections and analyzing powers. Further modifications in the absorptive potential were found necessary to extrapolate the modified potential to higher energies. The final potential is converted to a neutron-nucleus potential by use of standard Lane model assumptions and by accounting approximately for the Coulomb correction. Comparisons of measured and calculated proton reaction and neutron total cross sections are presented for ^{27}Al, ^{56}Fe, and ^{208}Pb. Medium-energy optical-model potentials for complex projectiles are briefly discussed in an appendix. 7 refs., 20 figs.

31689 **(LBL—24722) Role of compound nuclei in intermediate energy heavy ion reactions.** Moretto, L.G.;Ashworth, M.;Wozniak, G.J. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 16p. (CONF-8711116—8). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007384/JAW.

From 8. high energy heavy ion study; Berkeley, CA, USA (16 Nov 1987).

The presence of compound nuclei in the exit channels of many intermediate energy reactions is reviewed. The statistical decay of such compound nuclei may be responsible for many of the observed features. The role of compound nuclei in complex fragment production, multigragmentation and high energy gamma-ray emission is illustrated. 9 refs., 12 figs.

31690 **(LBL—24923) The effective stiffness of nuclei near magic numbers.** Meyers, W.D.; Rozmej, P. (Lawrence Berkeley Lab., CA (USA)). Feb 1988. Contract AC03-76SF00098. 4p. (CONF-880260—3).

From 5. winter workshop on nuclear dynamics; Sun Valley, ID, USA (22 Feb 1988).

This paper trys to explain the rapid increase in the apparent size of the rubidium isotope nuclei around the magic number N = 50. Droplet and deformation models are used to evaluate the measured data. 6 refs., 4 figs.

31691 **(UCID—21311) Cross sections and differential spectra for reactions of 2-20 MeV neutrons on /sup nat/Ni.** Blann, M.;Komoto, T.T. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 34p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007002/JAW.

This report summarizes product yields, secondary n,p and (alpha} spectra, and γ-ray spectra calculated for incident neutrons of 2-20 MeV on /sup nat/Ni targets. Results are all from the code ALICE, using the version ALISO which does weighting of results for targets which are a mix of isotpoes. Where natural isotopic targets are involved, yields and n,p,α sepctra will be reported weighted over isotopic yeilds. Gamma-ray spectra, however, will be reported for the most abundant isotope. We present product yields versus incident neutron energy, n,p,α spectra versus incident neutron energy, and calculated γ-ray spectra.

31692 **Reflection-asymmetric rotor model of odd A∼219—229 nuclei.** Leander, G.A.; Chen, Y.S. (UNISOR, Oak Ridge Associated Universities, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2744-2778(Jun 1988).

The low-energy spectroscopy of odd-A nuclei in the mass region A∼219—229 is modeled by coupling states of a deformed shell model including octupole deformation to a reflection-asymmetric rotor core. Theory and experiment are compared for the nuclei in which data are available: /sup 219,221,223,225/Rn, /sup 221,223,225,227/Fr, /sup 219,221,223,225,227/Ra, /sup 219,223,225,227,229/Ac /sup 221,223,225,227,229/Th, and ^{229}Pa. Overall agreement requires an octupole deformation $\beta_3 \sim 0.1$. The results throughout the region are synthesized to evaluate the model.

31693 **Trinucleon magnetic moments: 34-channel results.** Friar, J.L.; Gibson, B.F.; Payne, G.L.; Tomusiak, E.L.; Kimura, M. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2852-2858(Jun 1988).

Impulse approximation and isovector pion-exchange current contributions to the trinucleon magnetic moments are calculated using wave functions generated from solutions of the configuration-space form of the Faddeev equations for the Reid soft core, Argonne V_{14}, and super-soft-core C nucleon-nucleon force models and the Tucson-Melbourne or Brazilian three-nucleon force models. Numerical results for solutions with two-body partial waves having j≦4 (up to 34 channels) are reported. Agreement between theory and experiment appears reasonable for these nonrelativistic Hamiltonians which are restricted to one-pion exchange currents.

31694 **Trinucleon asymptotic normalization constants: Comparison of ^{3}He and ^{3}H.** Friar, J.L.; Gibson, B.F.; Lehman, D.R.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2859-2868(Jun 1988).

Calculations of the trinucleon S- and D-wave asymptotic normalization constants, with and without Coulomb effects, are extended to include all two-body partial waves up to j≦4 (34 three-body channels). Wave functions were generated with configuration-space, Faddeev-type equations for Hamiltonians based upon the two-body forces of Reid and the Argonne group, plus the Tucson-Melbourne and Brazilian model three-body forces. Comparison with previously published results is made. Results for C/sub S/, C/sub D/, eta, and D_2 are interpolated as a function of binding to extract best estimates for ^{3}H and ^{3}He. In agreement with our earlier (j< = 1) calculations, we find that Coulomb effects increase the S-wave asymptotic normalization of ^{3}He by less than 1% over that of ^{3}H and that Coulomb effects decrease the D-wave asymptotic normalization of ^{3}He relative to that of ^{3}H by about 6%. The distorted-wave Born approximation D-wave parameter D_2/sup C/ for ^{3}He is almost identical to D_2 for ^{3}H. Finally, we predict the ratio of the the D-wave to S-wave asymptotic normalization constants to be eta(^{3}H)≅0.046 and eta/sup C/(^{3}He)≅0.043. .AE

31695 **^{3}H and ^{3}He solutions for momentum-dependent potentials.** Friar, J.L.; Gibson, B.F.; Payne, G.L. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2869-2872(Jun 1988).

The configuration-space Faddeev equations for the trinucleon ground states are solved for the Paris, Nijmegen, and (coordinate-space version) Bonn potentials, both with and without a Coulomb interaction. These momentum-dependent forces are structurally identical, but have different functional forms parametrizing their radial dependence. Our triton binding energies agree with some previous results for the Paris potential and with all previous Bonn results, and our new Nijmegen solutions exhibit binding commensurate with all other "realistic" potentials except the Bonn. Other model properties are also calculated, including such observables as the rms radii, asymptotic normalization constants, and charge densities.

31696 **Evidence for state dependence of the imaginary part of the empirical optical potential.** Johnson, C.H.; Winters, R.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2340-2349(Jun 1988).

From the observed neutron scattering from ^{89}Y and ^{208}Pb at energies from 5 to 10 MeV, there is empirical evidence that the shape of the surface imaginary part of the neutron optical model potential depends upon energy; the radius increases and the diffuseness decreases with decreasing energy. It is shown that the empirical energy dependence for the radius of the surface imaginary potential is approximately the same as that for the positions of the surface nodes for those partial waves which have the same orbital angular momentum l and total neutron angular momentum j = l +- (12 as for the unoccupied bound single-particle states. The fact that those nodes are clustered near the center of the imaginary potential has the effect of reducing absorption for those partial waves. Therefore, the empirical variation in radius can be reinterpreted by a model for which the radius of the imaginary potential is constant but its strength depends upon the neutron orbital. This dependence can be adequately described by dividing the partial waves into two groups, one with the same quantum numbers l and j as for the bound unfilled orbitals and the other for the unbound states. In the case of n+^{208}Pb, for an assumed constant imaginary radius, the quality of the optical model descriptions to the data is improved and the dispersion-relation constraint is more nearly satisfied if the partial waves associated with the quasibound single-particle states are also included with those associated with the unoccupied bound single-particle states.

31697 **Numerical method for the calculation of continuum excitation amplitudes in time-dependent external field problems.** Bottcher, C.; Strayer, M.R.; Umar, A.S.; Oberacker, V.E. (Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2487-2494(Jun 1988).

We introduce a new numerical method for calculating continuum excitation probabilities of complex physical systems under the influence of external, time-dependent, and nonperturbative fields. The method utilizes a discretized form of the Hamiltonian on a space lattice and is particularly suited for large scale computations involving many-body systems. We perform a comparative study for a model problem by solving the same time-dependent Schroedinger equation in spherical and cylindrical coordinates. As a realistic example, we apply the method to the problem of prompt nucleon emission in low energy heavy-ion reactions.

31698 **Relativistic deuteron-nucleus scattering in the Kemmer-Duffin-Petiau formalism.** Kozack, R.E.; Clark, B.C.; Hama, S.; Mishra, V.K.; Kaelbermann, G.; Mercer, R.L.; Ray, L. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 6, 2898-2901(Jun 1988).

We present a description of the spin-1 Kemmer-Duffin-Petiau equations and make an application to deuteron-nucleus scattering. Comparison with d+ ^{58}Ni elastic scattering data at 400 MeV shows that the Kemmer-Duffin-Petiau model reproduces experimental spin observables quite well.

31699 **Near degeneracies of the intrinsic state energies of many-particle, many-hole deformed configurations.** Zheng, D.C.; Berdichevsky, D.; Zamick, L. (Department of Physics and Astronomy, Rutgers University, Piscataway, New Jersey 08855). *Physical Review Letters;* **60**: No. 22, 2262-2265(30 May 1988).

In deformed Hartree-Fock calculations with Skyrme interactions, a near degeneracy of the intrinsic state energies of n-particle, n-hole (Np-Nh) deformed states with differing n has been obtained. For example, in ^{40}Ca the 8p-8h intrinsic state energy is close to but even lower than that of the 4p-4h deformed state. Whether there is an underlying symmetry to explain this near degeneracy has yet to be determined.

31700 **Comment on "Spin-spin dependence of total cross sections as an effect of static nuclear deformation".** Gould, C.R.; Roberson, N.R.; Thompson, W.J. (Triangle Universities Nuclear Laboratory Durham, North Carolina 27706). *Physical Review Letters;* **60**: No. 22, 2335-2335(30 May 1988).

A Comment on the Letter by V. Hnizdo and K. W. Kemper, Phys. Rev. Lett. 59, 1892 (1987).

31701 **Isospin distribution of quadrupole strength in ^{118}Sn: Comparison with pion, nucleon, and electron scattering.** Brown, V.R.;Carr, J.A.;Madsen, V.A.;Petrovich, F. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 4, 1537-1548(Apr 1988). Contract W-7405-ENG-48.

The isospin structure of the quadrupole strength in ^{118}Sn is examined by a variety of means in an attempt to understand the surprisingly large amount of isovector strength extracted from some recent $\pi^-\pi^+$ experiments in the excitation-energy region (below 2(h2π)ω) expected for the isoscalar giant-quadrupole resonance. The ratio of the giant-quadrupole resonance neutron and proton multipole matrix elements for ^{118}Sn determined from $\pi^-\pi^+$ data is M/sub n/M/sub p/ = 1.9 +- 0.4 compared to calculations which range from 1.1 to about NZ (1.36). It is demonstrated that this large ratio has unrealistic consequences in random-phase approximation mixing of the giant states into the first 2^+ state transition (core polarization), which has been independently studied by other probes and is in rather good agreement with quasiparticle random-phase approximation calculations, which have M/sub n/M/sub p/$\leqq$NZ for the isoscalar giant-quadrupole resonance. Quasiparticle random-phase approximation transition densities are used to calculate pion, proton, and neutron cross sections to the isoscalar giant-quadrupole resonance and the first 2^+ state using microscopic reaction models. A comparison of B(E2) from the same structure model is made to the various data for the first 2^+ transition and to the ^{116}Sn(e,e') data on the isoscalar giant-quadrupole resonance. Although not completely conclusive because of the lack of reliable (e,e') data, the evidence from all these comparisons is that the $\pi^-\pi^+$ results are at odds with the results of other probes and with nuclear structure theory and that the problem seems to be with the π^+ scattering results.

31702 **Stochastic calculation of tunneling in systems with many degrees of freedom.** Alexandrou, C.;Negele, J.W. (Center for Theoretical Physics, Laboratory for Nuclear Science Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 4, 1513-1526(Apr 1988).

A new method is presented for the stochastic solution of tunneling problems in quantum many-body systems. The primary practical problem of trapping in local minima of the action is overcome by extending the standard implementation of the Metropolis algorithm to include collective updates motivated by semiclassical instanton solutions. We demonstrate the accuracy of our method in the case of tunneling in one degree of freedom and apply it to a model many-fermion system in one spatial dimension which undergoes spontaneous symmetric fission.

31703 **Nucleon scattering from ^{208}Pb at low and intermediate energies.** Schutt, R.L.; Shamu, R.E.; Lisowski, P.W.; Moore, M.S.; Morgan, G.L. (Western Michigan Univ., Kalamazoo (USA); Los Alamos National Lab., NM (USA)). *Physics Letters* [*Section*] *B;* **203**: No. 1/2, 22-25(24 Mar 1988).

A phenomenological optical model analysis of neutron-^{208}Pb data from 2 to 250 MeV has been performed. The energy dependence of the real potential strength was found to be linear up to about 60 MeV and logarithmic above that energy. The strength of the real isovector potential, determined from a comparison with proton-^{208}Pb results, was found to have a negligible energy dependence below about 50 MeV.

31704 **Magnetic response of closed-shell +- 1 nuclei in Dirac-Hartree approximation.** Shepard, J.R.;Rost, E.;Cheung, C.;McNeil, J.A. (Department of Physics, University of Colorado, Boulder, Colorado 80309). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1130-1141(Mar 1988).

We formulate a systematic approximation to the Dirac-Hartree description of closed-shell +- 1 nuclei using the closed-shell basis. Expectation values of one-body operators include random-phase-approximation-like loop corrections to the single particle (or hole) results. We use a nonspectral form of the Hartree propagator which allows inclusion of positive- and negative-energy continuum contributions exactly. The loop corrections quench the single-particle isoscalar magnetic moments back to the Schmidt values, resulting in good agreement with experiment. Elastic M1 electron scattering form factors are also quenched at low q. However, the loop corrections vanish at q$\approx$1.2 fm^{-1} and change sign so as to enhance the single-particle result at still higher momentum transfers. This raises the possibility that experimental signatures of the strong relativistic nuclear dynamics characteristic of Dirac-Hartree models may be present in elastic M1 form factors for closed-shell +- 1 nuclei.

31705 **Temperature-dependent shell effects in ^{16}O and ^{40}Ca with a realistic effective Hamiltonian.** Bozzolo, G.;Civitarese, O.;Vary, J.P. (Physics Department, Case Western Reserve University, Cleveland, Ohio 44106 and Physics Department, Oberlin College, Oberlin, Ohio 44074). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1240-1244(Mar 1988).

Finite temperature properties of ^{16}O and ^{40}Ca are evaluated self-consistently, with a realistic effective Hamiltonian. Resulting thermodynamic functions such as the free energy are analyzed to extract their smooth thermal dependence and the thermal dependence of the shell effects. The temperature dependence of single particle energies is large compared to results obtained with phenomenological Hamiltonians. Gaps between shell centroids decrease uniformly with increasing temperature. However, the spin-orbit splitting decreases even faster, so that the shell gap follows a pattern of an initial increase with temperature followed by an eventual decrease to zero at high T. This thermal blocking of the Hartree-Fock spin-orbit potential is associated with the thermal sensitivity of surface properties. The approximation of thermal occupation of the T = 0 spectrum is also invalidated and the self-consistent treatment is necessary to obtain physical quantities such as the level density parameter as a function of T.

31706 **Thermodynamic coefficients of hot nuclei.** Saraceno, M.;Vary, J.P.;Bozzolo, G.;Miller, H.G. (Departamento de Fisica, Comision Nacional de Energia Atomica, 1429 Buenos Aires, Argentina). *Physical Review* [*Section*] *C: Nuclear Physics;* **37**: No. 3, 1267-1280(Mar 1988).

We present a general method to evaluate large amplitude time-dependent Hartree Fock dynamics in a single mode and in the presence of a thermal bath. We apply the method in the small oscillation regime to isothermal and isentropic breathing mode oscillations. We employ realistic microscopic effective Hamiltonians with phenomenological extensions to large model spaces and obtain thermodynamic coefficients for ^{16}O and ^{40}Ca. Coefficients for the in-

compressibilities, specific heats, and thermal expansion are obtained along with breathing mode frequencies as a function of temperature. A significant effect due to the nonlocality of the interaction on the collective mass is obtained. The interaction produces a remarkably low value for the incompressibility while providing an adequate description of the breathing mode energy.

31707 **Geometrical structure and critical phenomena in the fermion dynamical symmetry model: SO(8).** Zhang, W.;Feng, D.H.;Ginocchio, J.N. (Department of Physics and Atmospheric Science, Drexel University, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1281-1294(Mar 1988).

Geometrical properties of the recently proposed fermion dynamical symmetry model via the coherent state methodology is presented. Critical phenomena of this model are discussed in detail.

31708 **Dissipation and forces in time-dependent Hartree-Fock calculations.** Reinhard, P.;Umar, A.S.;Davies, K.T.R.;Strayer, M.R.;Lee, S. (Joint Institute for Heavy-Ion Research, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1026-1035(Mar 1988).

We have performed time-dependent Hartree-Fock calculations for the $^{16}O+^{16}O$ system using various parametrizations of the Skyrme force. These calculations also include the spin-orbit part of the Skyrme force. We have refitted the finite-range version of the Skyrme force to the ground state properties of eight nuclei with improved accuracy. Particular emphasis is given to comparisons of calculations with and without the spin-orbit force. We see a strong sensitivity of the results to the different parametrizations of the effective interaction. The spin-orbit force introduces a significant enhancement of the dissipation. A schematic model of heavy-ion scattering is used to investigate the origin of the observed sensitivity. We find that the dissipation is essentially determined by the additional residual interaction.

31709 **Pion spectra in equilibrium models of nuclear collisions.** Hahn, D.;Glendenning, N.K. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California at Berkeley, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1053-1061(Mar 1988). Contract AC03-76SF00098.

We calculate pion spectra within three simple models of pion production in relativistic heavy ion collisions. All three models are based on particle freeze-out from thermal and chemical equilibrium. In the first one, nucleons, pions, and Δ resonances freeze out at a fixed temperature and density. The spectra are a superposition of thermal pions and pions from the decay of the Δ resonance. In the second model, we assume that pions are radiated from a hot, spherical source of nuclear matter, which loses energy because of this radiation. In the last calculation, we employ a hydrodynamic model of the expansion process to determine the pion spectra produced by a sequential freeze-out at fixed density and different times and temperatures. Only this last model gives a shape of the pion distribution similar to the experimental one. It is found that three different effects contribute to the concave shape of the spectra in this model.

31710 **Configuration dependence in calculations for pion inelastic scattering near N = 28.** Oakley, D.S.;Fortune, H.T. (University of Texas, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1126-1129(Mar 1988).

A recent publication presented angular distributions for 180-MeV pion inelastic scattering for several N{similar←to}28 nuclei. Proton E2 matrix elements extracted from those data for certain states were systematically larger than those inferred from γ decay. A possible explanation for these anomalies is discussed.

31711 **Relativistic impulse approximation description of polarized proton elastic scattering from polarized ^{13}C.** Ray, L.;Hoffmann, G.W.;Barlett, M.L.;Lumpe, J.D.;Clark, B.C.;Hama, S.;Mercer, R.L. (Department of Physics, University of Texas at Austin, Austin, Texas 78712). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1169-1182(Mar 1988).

The elastic scattering of intermediate energy polarized protons from polarized ^{13}C is studied within the framework of the relativistic distorted wave Born approximation using the relativistic impulse approximation to describe the projectile–target nucleon interaction. Sensitivities of observables to (1) the upper and lower components of the valence nucleon wave function, (2) the Lorentz form of the two-body interaction, (3) isoscalar three-vector currents, and (4) the individual strengths of the separate Lorentz terms in the two-body interaction are calculated and discussed. The bound state wave functions for the $1p_{\frac{1}{2}}$ valence neutron used in the calculations are taken from relativistic mean field theory and from traditional, nonrelativistic Woods-Saxon eigenstate solutions. Predictions obtained using either pseudoscalar or pseudovector projectile-nucleon coupling forms are compared. Possible effects on the p-arrow-right+ ^{13}C-arrow-right polarized target spin observables due to contributions of the core nucleons to the effective isoscalar three-vector current are discussed and investigated using a simple model. What can be learned from normal (i.e., perpendicular to scattering plane) and transverse (i.e., approximately perpendicular to beam, in the scattering plane) polarized target spin observables, as well as unpolarized p-arrow-right+ ^{13}C elastic scattering observables are discussed. The results suggest that new nuclear structure information, additional effective interaction phenomenology, and further constraints on the Lorentz character of the effective two-body interaction can in principle be obtained from analyses of p-arrow-right+ ^{13}C-arrow-right elastic scattering data. Experiments to obtain such data are encouraged.

31712 **Reply to Comment on "Interpretation of relativistic dynamical effects in proton-nucleus scattering".** Picklesimer, A.;Tandy, P.C. (Physics Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] C: Nuclear Physics;* **37**: No. 3, 1335-1337(Mar 1988). Contract W-7405-ENG-36.

At issue is the identification of the physical mechanism that causes the distinction between the nucleon-nucleus scattering observables predicted by Dirac and Schroedinger implementations of the impulse approximation for the optical potential. We clarify the decisive role of an early variant of the Dirac approach in addressing this issue. Using this basis, recent conjectures concerning the physical mechanism are easily seen to be misleading. The elimination of apparent formal mathematical difficulties at high momenta, which arise from the noncompactness of local form factors, is also straightforward within this approach using well-known techniques in scattering theory.

31713 **Quark mobility in extended nuclear matter.** Sivers, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Annals of Physics (New York);* **182**: No. 1, 157-176(15 Feb 1988). Contract W-31-109-ENG-38.

The propagation of an energetic quark through extended nuclear matter is analyzed in terms of a simple model in which localization of color is imposed through chromoelectric flux tubes. A mobile quark in the nuclear medium creates a disturbance which affects neighboring nucleons. The model suggests that the spatial properties of the disturbance involve a competition among different dynamical mechanisms. Experimental measurements involving the target fragmentation region in deep-inelastic leptoproduction on large nuclei may help specify some of the important features of nuclear dynamics. copyright 1988 Academic Press, Inc.

31714 **Inclusive γ and π^0 cross sections in heavy-ion reactions.** Ernst, D.J.;Strayer, M.R. (Texas A and M Univ., College Station (USA). Dept. of Physics;Oak Ridge National Lab., TN (USA)). *Journal of Physics F (London). Metal Physics (London);* **14**: No. 2, L37-L44(Feb 1988). Contract AC05-84OR21400.

Perturbation theory in a time-dependent basis is used to derive formal expressions for pion and gamma emission in heavy-ion reactions. The structure of the theory motivates an external mean-field phenomenology as a representation of the actual mean field plus lowest-order collision dynamics. The source function for the emission process is identified as a Wigner function constructed from the time Fourier transform of the nuclear wavefunctions. A simple model of the Wigner function is constructed and used to relate the production cross section for πsup(0) and γ in the reaction

^{14}N + Ni at a laboratory bombarding energy per nucleon of 35 MeV. A direct relation between π^0 and γ cross sections is predicted to hold in the region of high gamma ray energy where the gamma emission is dominated by spin currents.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 30986, 31908

31715 **(BHR—38) Multi-group diffusion-theory for a gamma point source in an infinite medium.** Oelgaard, P.L. (Danmarks Tekniske Hoejskole, Lyngby. Afdelingen for Elektrofysik). Feb 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753005/JAW.

In this report a method for calculating the gamma flux around a point source, situated in an infinite medium, has been derived. The method has been based on multi-group, diffusion theory. Formulas for the gamma flux for the one, two and three group cases are presented, and it is outlined how the formulas of an n-group calculation are obrained. A short discussion on how the relevant nuclear constants are obtained, is also given.

31716 **Elastic scattering in thick targets and edge scattering.** Van Ginneken, A. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review [Section] D: Particles and Fields;* 37: No. 11, 3292-3307(1 Jun 1988).

Physical processes causing limited ($<\sim 1\%$) energy loss to high-energy particles traversing bulk matter are examined and their cross sections cast in a form suitable for use in Monte Carlo transport calculations. Special attention is paid to scattering off edges. An algorithm is developed, based on the Fermi distribution of multiple Coulomb scattering, which generates first-passage distributions for escaping particles and more generally for transport of particles undergoing multiple scattering in the presence of an edge. Implementation of the various processes and of the edge-scattering algorithm into a Monte Carlo code are briefly indicated. A sample of results obtained with this code is included.

31717 **Planar channeling in superlattices: Theory.** Ellison, J.A.; Picraux, S.T.; Allen, W.R.; Chu, W.K. (Department of Mathematics, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review [Section] B: Condensed Matter;* 37: No. 13, 7290-7305(1 May 1988).

The well-known continuum model theory for planar channeled energetic particles in perfect crystals is extended to layered crystalline structures and applied to superlattices. In a strained-layer structure, the planar channels with normals which are not perpendicular to the growth direction change their direction at each interface, and this dramatically influences the channeling behavior. The governing equation of motion for a planar channeled ion in a strained-layer superlattice with equal layer thicknesses is a one degree of freedom nonlinear oscillator which is periodically forced with a sequence of δ functions. These δ functions, which are of equal spacing and amplitude with alternating sign, represent the tilts at each of the interfaces. Thus upon matching an effective channeled particle wavelength, corresponding to a natural period of the nonlinear oscillator, to the period of the strained-layer superlattice, corresponding to the periodic forcing, strong resonance effects are expected. The condition of one effective wavelength per period corresponds to a rapid dechanneling at a well-defined depth (catastrophic dechanneling), whereas two wavelengths per period corresponds to no enhanced dechanneling after the first one or two layers (resonance channeling). A phase plane analysis is used to characterize the channeled particle motion. Detailed calculations using the Moliere continuum potential are compared with our previously described modified harmonic model, and new results are presented for the phase plane evolution, as well as the dechanneling as a function of depth, incident angle, energy, and layer thickness. General scaling laws are developed and nearly universal curves are obtained for the dechanneling versus depth under catastrophic dechanneling.

6550 Medical Physics

REFER ALSO TO CITATION(S) 30951

31718 **(SSI—87-16) Project Chernobylsk - Long-term Restriction of Cesium Ingestion via Food-stuffs.** (National Inst. of Radiation Protection, Stockholm (Sweden)). 29 Apr 1987. 13p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753027/JAW.

Description of the method to limit cesium ingestion via food, stipulated by the National Institute of Radiation Protection, Sweden. The dose contribution from food-stuffs is limited to approximately 1 millisievert per year. This means that the yearly ingestion of cesium 137 for the majority of the Swedish population will be limited to 50000 Bq. The Nordic agreements in the field are described.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 30548, 30550, 30688, 30693, 31451, 31452, 31456, 31812, 31828

31719 **(AD-A—189193/6/XAB) High-resolution electron-energy-loss spectroscopy of hydrogen chemisorption at Nb(100) surfaces: evidence for subsurface absorption sites.** Li, Y.; Erskin, J.L.; Diebold, A.C. (Texas Univ., Austin (USA). Dept. of Physics). 15 Oct 1986. 5p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 34, No. 8, 5951-5954(15 Oct 1986).

The interaction of hydrogen with niobium(100) surfaces was studied by use of high-resolution electron-energy-loss spectroscopy, low-energy electron diffraction, and work-function measurements. Experimental results indicate that hydrogen absorbs on Nb(100) at tetrahedral sites below the surface. Hydrogen in these subsurface sites exhibits reversible temperature-dependent effects compatible with the self-trapped subsurface sites proposed to account for the novel kinetics of hydrogen uptake by Nb.

31720 **(AD-A—189194/4/XAB) High-resolution low-energy electron reflection from W(100) using the electron energy-loss spectrometer: a step towards quantitative analysis of surface vibrational spectra.** Erskine, J.L. (Texas Univ., Austin (USA). Dept. of Physics). Aug 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Vacuum Science and Technology A, Vol. 5, No. 4, 435-439(Aug 1987).

High-resolution low-energy electron-reflection measurements and electron-energy-loss measurements for clean W(100) and for the hydrogen-saturated phase (B(1)) on W(100) are reported. The ability to perform both low-energy reflectance, low energy electron diffraction, and high-resolution electron energy-loss experiments on the same crystal using the same electron optics permits several novel experiments. For example, it is possible to quantitatively test the dipole scattering mechanism and examine dipole and impact loss cross sections under precisely defined scattering conditions (i.e., under diffracted-beam emergence conditions or at energies corresponding to reflectance resonance conditions). Under certain scattering conditions, the dipole scattering selection rule is shown to break down. Suitable modifications of the electron optics control electronics also permit direct measurements of the cross-section energy dependence of vibrational losses. These new features represent an important step towards quantitative applications of vibrational spectroscopy based on comparing electron-energy-loss spectroscopy signals from chemisorbed species on different crystal surfaces.

31721 **(CONF-880567—1) The theory of random alloys.** Pinski, F.J.;Nicholson, D.M.;Stocks, G.M.;Butler, W.H.;Johnson, D.D.;Gyorffy, B.L. (Cincinnati Univ., OH (USA); Oak Ridge National Lab., TN (USA); Naval Research Lab., Washington, DC (USA); Bristol Univ. (UK)). May 1988. Contract AC05-84OR21400. 11p.

From 3. international conference on supercomputing; Boston, MA, USA (15 May 1988).

We review the theory of random substitutional alloys which we have developed from microscopic quantum mechanics. This theory is based on the understanding of the electron "glue" which is responsible for cohension. We describe how many properties can be calculated from first-principles, i.e., only the atomic number sand concentrations are required inputs. These properties include the equilibrium volume, short-range order parameters, phase diagrams, magnetic properties, and the transport coefficients. Three types of mean-field approximation are used in these calculations. Density functional theory is used to reduce the "many-electron" problem to that of a single electron moving in mean field due to the other electrons, the coherent-potential approximation is used to replace the disordered potential field of the random alloy by an effective potential, and furthermore, the statistics of site occupation is treated in the mean field apporximation by the concentration functional theory (CFT) in the determination of short-range order. 38 refs., 5 figs.

31722 **(DOE/DP/40200—54) Thermal conductivities for thin films of SiO_2, Al_2O_3 and MgF_2 on dielectric substrates.** Jacobs, S.D.; Gilman, S.E.; Smith, D.J.; Angeley, D.G.; Lambropoulos, J.C. (Rochester Univ., NY (USA). Lab. for Laser Energetics; Rochester Univ., NY (USA). Dept. of Mechanical Engineering). Jan 1987. Contract FC08-85DP40200. 18p. (CONF-861038—11).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

The thermal conductivities for films of three dielectric materials have been evaluated with a high-precision thermal comparator. Single layers of SiO_2 and Al_2O_3, deposited with e-beam techniques on single crystal silicon substrates, exhibit thermal conductivities three orders of magnitude below their bulk, single crystal counterparts. MgF_2 films on single crystal MgF_2 or Al_2O_3 show no reduction from what would be expected for bulk, single crystals. With this nondestructive film-on-substrate technique we have also measured the thermal barrier effect from the oxidized surface layer of Si overcoated with our thin films. 13 refs., 7 figs.

31723 **(DOE/ER/13441—4) Interactions of molecules with surfaces: Progress report, 16 March 1987-30 March 1988.** Greene, E.F. (Brown Univ., Providence, RI (USA)). 1988. Contract FG02-85ER13441. 5p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007950/JAW.

Progress is reported on three projects: (1) ions formed when alkali metal atoms strikes a surface;(2) surface temperature rise when an expanding gas hits a surface;and (3) use of diffraction of He atoms to follow changes in the Si crystal surface. (DLC)

31724 **(DOE/ER/13745—1) [Metastable enhancement of C^- and O^+ capture reactions]: Progress report.** Thomas, E.W. (Georgia Tech Research Corp., Atlanta (USA)). 1988. Contract FG05-87ER13745. 6p.

The program objective is to study C^+ and O^+ charge transfer in gases (H, H_2 and He) separately for ground and metastable exicted states of the projectile. Also we will study secondary electron ejection and particle ejection (sputtering) from surfaces by these same incident species to determine whether processes on surfaces are in any way influenced by the projectile being in a metastable state. Preliminary studies of metastable sputtering have been completed, are described and reveal that metastable oxygen enhances chemical sputtering of C; this observation may be of some significance in the modelling of first wall conditions in MFE (magnetic fusion energy) devices which employ carbon coated walls or limiters. 6 refs.

31725 **(DOE/ER/45265—T1) Direct synthesis and optimization of Fe based rare earth transition metal permanent magnet systems: Progress report, August 1, 1987-March 31, 1988.** Cadieu, F.J. (Queens Coll., Flushing, NY (USA). Dept. of Physics; City Univ. of New York, NY (USA). Research Foundation). 23 Mar 1988. Contract FG02-86ER45265. 14p.

High coercive force rare earth transition metal permanent magnet systems are being either directly synthesized onto heated substrates or subsequently crystallized from thick films originally deposited in an amorphous form. Generally thick films have been prepared by RF sputtering from a set of three targets so that films with or without a composition gradient along the length of the substrates can be created. For gradient composition films, a detailed, reproducible, and systematic study of the entire phase field of a system can be studied by observing separate regions of a single substrate. Normally films have been synthesized with an applied magnetic field of 2.5 kOe in the plane of the substrates during the sputter deposition. This has allowed special anisotropies to be introduced into the growing films. By employing what we term selectively thermalized sputtering the desired phases can be directly synthesized onto heated substrates so that the samples are highly textured. For example, films of the $SmCo_5$ compound can be synthesized with either a (200) or (110) predominant crystal texturing. The intrinsic coercive forces, /sub i/H/sub c/, of these differently textured films are very different. For the (110) textured $SmCo_5$ films /sub i/H/sub c/ values of 23 kOe have been observed for a sputtered films without any subsequent heat treatments. In the film plane static energy products the order of 20 MG{endash}Oe have been observed for a number of different crystal texturing so that films exhibit either an easy magnetic axis in the film plane or perpendicular to the film plane depending upon whether the c-axis is predominantly textured into or out of the film plane.

31726 **(IC—87/192) On the positron-trapping states of metal mono-vacancies.** Sankar, S.; Iyakutti, K. (International Centre for Theoretical Physics, Trieste (Italy); Madurai Kamaraj Univ. (India). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702645/JAW.

A model calculation based on the static dielectric screening theory has been performed to estimate the probable number of positron-trapping levels in metal mono-vacancies and it is shown that there cannot be more than one. (author). 8 refs, 1 tab.

31727 **(IC—87/200) Spectral properties and scaling relations in off diagonally disordered chains.** Ure, J.E.; Majlis, N. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702649/JAW.

We obtain the localization length L as a function of the energy E and the disorder width W for an off-diagonally disordered chain. This is done performing numerical simulations involving the continued fraction representations of the transfer matrix. The scaling relation L=W/sup s/ is obtained with values of the exponent s in agreement with calculations of other authors. We also obtain the relation L ~ chemical bondEchemical bond/sup v/ for E -> 0, and use it in the Herbert-Spencer-Thouless formula for L to describe the singularity of the density of states near E=0. We show that the slightest diagonal disorder obliterates this singularity. A practical method is presented to calculate the Green function by exploiting its continued fraction expansion. (author). 20 refs, 4 figs.

31728 **(IC—87/201) Gaussian approximation for partition function in disordered system.** Lin Jiancheng. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702650/JAW.

In this paper we use Gaussian approximation for distribution of partition function to describe a general disordered system. For quenched disordered system, this approximation predicts a phase transition at eta=1, where (Z-bar)σ ~ eta/sup N/ and σ is the fluctuation of the partition function. Above and below phase transition, the free energy -βf of the system is given by (l)N ln Z-bar and (l)N ln σ respectively. As a simple example, we calculate SK spin glass model and briefly discuss the results. (author). 3 refs, 2 figs.

31729 **(IC—87/204) Theory of surface melting and nonmelting.** Tosatti, E. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702652/JAW.

Some of the attempts that have been made to understand the melting behavior of a low-index crystal surface are reviewed. 28 refs, 7 figs.

31730 (IC—87/209) Tight-binding using the recursion method. Vargas, P. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702657/JAW.

The recursion method is reviewed and a new terminator for the continued fraction representation of the Green function is presented. A comparison with other known terminators is made by reconstructing known functions. Test calculations of the density of states in bcc-Fe is done using the first principles canonical tight-binding description of O.K. Andersen for the construction of the Hamiltonian in a cluster of 400 atoms. The calculation required a small amount of CPU-time and it was performed on a personal computer. Compared with more exact k-space methods, the result reveals that the essential features of the DOS are very well reproduced, even the saturation magnetization. (author). 17 refs, 7 figs.

31731 (IC—87/213) On the use of spin-glass concepts in random automata networks. Miranda, E.N.; Parga, N. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702661/JAW.

We apply concepts and techniques developed in the context of the mean field theory of spin glasses to networks of random automata. This approach, proposed recently by Derrida and Flyvbjerg, may be useful in understanding the multivalley structure of the Kauffman model. In particular, we test it under the introduction of an overlap scale and in the presence of noise. (author). 7 refs, 4 figs.

31732 (IC—87/218) Theoretical investigation of image states of the hydrogen covered Cu (100). Steslicka, M.; Zagorski, M.; Jurczyszyn, L. (Wroclaw Univ. (Poland)). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702662/JAW.

A model of atomic hydrogen covered Cu(100) is presented and the calculated energy spectrum of localized electronic states in the X gap of Cu(100) is discussed. These states form a series of unoccupied adsorption image states (for n/sub α/ = 2,3,...) lying below the vacuum level V_0 and having energies E/sub nα/ which satisfy the formula E/sub nα/ = V_0 - 10n/sub n/^{2} (eV). The lowest state (n/sub α/ = 1) is expected to lie about 5.5 (eV) below Fermi level. (author). 19 refs, 6 figs, 1 tab.

31733 (IC—87/231) Multiphoton transitions in semiconductors in the non-perturbative approach. Iqbal, M.Z.; Hassan, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702664/JAW.

Transition rates for multiphoton absorption via direct band-to-band excitation have been calculated using a non-perturbative approach due to Jones and Reiss, based on the Volkov type final state wave functions. Both cases of parabolic and non-parabolic energy bands have been included in our calculations. Absorption coefficients have been obtained for the cases of plane polarized and circularly polarized light. In particular, two-photon absorption coefficients are derived for the two cases of polarization for the parabolic band approximation as well as for non-parabolic bands and compared with the results based on perturbation theory. Numerical estimates of the two photon absorption coefficients resulting from our calculations are also provided. (author). 10 refs, 1 tab.

31734 (IC—87/236) Effects of electron-electron interactions on the nature of the eigenstates in amorphous materials. Brezini, A.; Sebbani, M. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702666/JAW.

A Hubbard model with random site energies is used to investigate the electron localization effects associated with both disorder and electron-electron interactions on a Cayley tree. Extensive results have been reported on the ground states properties of the system. In particular, two regimes have been found: if the electron-electron interaction parameter U is greater than the disorder parameter W, it appears to be significant in localizing electronic states otherwise it may be viewed as weakly perturbating the effects of the disorder. (author). 30 refs, 3 figs.

31735 (IC—87/239) Electronic structure of NaSn. El Hasan, M.; Tomak, M. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702669/JAW.

The electronic structure calculation of β-NaSn using the recursion method is reported. The two other fictitious crystal structures are also considered to better study the effect of Sn tetrahedra formation. It is found that Sn tetrahedra formation in these alloys may lead to a semiconducting behaviour. (author). 8 refs, 4 figs.

31736 (IC—87/264) Sum rules for surface and adsorbate electronic excitations and van der Waals scattering at surfaces. Lovric, D.; Gumhalter, B. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702670/JAW.

The relevance of van der Waals interactions in the scattering of neutral atoms from adsorbates has recently been confirmed by highly sensitive molecular beam techniques. The theoretical descriptions of the collision dynamics which followed the experimental studies have necessitated very careful qualitative and quantitative examinations and evaluations of the properties of atom-adsorbate van der Waals interactions for specific systems. In this work we present a microscopic calculation of the strengths and reference plane positions for van der Waals potentials relevant for scattering of He atoms from CO adsorbed on various metallic substrates. In order to take into account the specificities of the polarization properties of real metals (noble and transition metals) and of chemisorbed CO, we first calculate the spectra of the electronic excitations characteristic of the respective electronic subsystems by using various data sources available and combine them with the existing theoretical models. The reliability of the calculated spectra is then verified in each particular case by universal sum rules which may be established for the electronic excitations of surfaces and adsorbates. The substrate and adsorbate polarization properties which derive from these calculations serve as input data for the evaluation of the strengths and reference plane positions of van der Waals potentials whose computed values are tabulated for a number of real chemisorption systems. The implications of the obtained results are discussed in regard to the atom-adsorbate scattering cross sections pertinent to molecular beam scattering experiments. (author). 37 refs, 5 figs, 3 tabs.

31737 (IC—87/270) Localization in superlattices with randomness in layer thickness. Yuan Jian; Tsai Chienhua. (Jiao-Tong Univ., Shanghai (China). Inst. of Condensed Matter Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702674/JAW.

The localization length for electrons in superlattices with randomness in layer thickness is studied in both the commensurate and the incommensurate cases. It is demonstrated that disorder limits the electrons to see only structures within the extent of their wave functions and to be hardly effected by any long range correlation. (author). 4 refs, 6 figs.

31738 (IC—87/271) On the band offset in PbTe-PbEuSeTe quantum wells. Dios Leyva, M. de; Rodriguez, A.M. (Havana Univ., La Habana (Cuba). Dept. of Theoretical Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702675/JAW.

The influence of the experimental uncertainties in carrier density and effective mass on the theoretical determination of the

band offset in PbTe-PbEuSeTe quantum wells is analyzed in the framework of the two-band Dimmock model. It is shown that these uncertainties could lead to a large indetermination of the calculated band offset and that two different values of the band offset are compatible with the experimental data. (author). 11 refs, 2 figs.

31739 **(IC—87/284) System suitable for observing surface plasmon in a semi-infinite semiconductor superlattice.** Zhu Yun; Cai Shengshan; Zhou Shixun. (Fudan Univ., Shanghai, SH (China). Dept. of Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702686/JAW.

A model of semi-infinite semiconductor superlattice topped with a metal-insulator(M-I-SL) is suggested. A modified Giuliani-Quinn surface plasmon is found. It is interesting to note that the frequency and critical wavelength can be arbitrarily chosen by varying thickness of the insulator. In particular, a new type of surface plasmon with null critical wave vector exists only below the bulk plasmon continuum, and the frequency is directly related to the ratio of thickness of the insulator d to the superlattice spacing a. (author). 9 refs, 3 figs.

31740 **(IC—87/288) Dilute random field Ising model by finite cluster approximation.** Benyoussef, A.; Saber, M. (Laboratoire de Magnetisme, Dept. de Physique, Faculte des Sciences, Rabat (Morocco)). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702690/JAW.

Using the finite cluster approximation, phase diagrams of bond and site diluted three-dimensional simple cubic Ising models with a random field have been determined. The resulting phase diagrams have the same general features for both bond and site dilution. (author). 7 refs, 4 figs.

31741 **(IC—87/289) Localized excitations in one-dimensional molecular crystal with structural defect.** Cabric, B.; Ristovski, L. (International Centre for Theoretical Physics, Trieste (Italy); Faculty of Natural Sciences, Beograd (Yugoslavia)). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702691/JAW.

The linear chain in molecular crystal with local structural defect (dislocation) has been considered. By applying a particular theoretical approach the energies of localized excitations appearing in the system are determined and the dependence of these energies on the perturbation parameters is discussed. The theoretical approach is formulated in such a way to reduce the problem to the analysis of an ideal molecular chain with some extra off-diagonal terms in the Hamiltonian. These extra terms are considered as perturbation caused by the nonideality of the molecular chain. The results of the present study provide the first step towards the quantitative understanding of the effects of structural disorder on exciton dynamics, energy transfer processes and absorption line shapes in quasi-one-dimensional molecular crystals. (author). 4 refs, 2 figs.

31742 **(IC—87/295) Finite cluster renormalization group for disordered two-dimensional systems.** El Kenz, A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702695/JAW.

A new type of renormalization group theory using the generalized Callen identities is exploited in the study of the disordered systems. Bond diluted and frustrated Ising systems on a square lattice are analyzed with this new scheme. (author). 9 refs, 2 figs, 2 tabs.

31743 **(IC—87/297) Melting of 2D monatomic solids: Lennard-Jones system.** Yi, Y.M.; Guo, Z.C. (International Centre for Theoretical Physics, Trieste (Italy); Anhui Univ., Hefei (China). Physics Dept.). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702697/JAW.

The Lennard-Jones interaction has been introduced into the Collins mix lattice of 2D liquids. By means of rigorous calculation of the total potential and the free area, the Gibbs functions for 2D liquid and solid have been derived. The melting line obtained from the phase transition equation agrees quite well with the result of recent computer simulation experiments. The obtained reduced temperature of the triple point T*/sub t/=0.438 agrees with the data measured in experiments of some inert gas monolayers adsorbed on graphite as well as in computer simulation experiments. (author). 11 refs, 7 figs, 3 tabs.

31744 **(IC—87/316) Effect of annealing and oxide layer thickness on doping profiles shape of "through-oxide" implanted P^+ ions in textured silicon.** El-Dessouki, M.S.; Galloni, R. (International Centre for Theoretical Physics, Trieste (Italy); CNR, Bologna (Italy). Lab. di Chimica e Tecnologia dei Materiali e dei Component per l'Elettronica). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702710/JAW.

Phosphorous ions at energies of 60+100 KeV, and doses $(4+5)\times10^{15}$ atomcm^{-2} have been implanted randomly through SiO_2 layers into textured silicon crystals. The penetration profiles of the P^+ ions have been determined by means of differential sheet resistivity and Hall-effect, together with the anodic oxidation stripping technique. The effect of the oxide layer thickness, annealing temperature on the junction properties has been studied. The damage produced by implantation, has also been investigated using transmission electron microscope (TEM). From the mobility measurements of the free carriers as a function of depth through the junction, two minima have been observed in through oxide implanted samples. The one nearer to the Si-SiO_2 interface (at about 200A from the interface) was related to the damage produced by the recoil oxygen atoms from the oxide layer into silicon. The deeper minimum is lying at $\sim 0.2\mu m$ from the interface and was attributed to the damage produced by the implanted P^+ ions, which caused clusters and defect loops after annealing. This damage was observed through TEM photographs. The optimum conditions for producing shallow junction without losing much of the implanted P^+ ions through the oxide layer were estimated. (author). 22 refs, 7 figs, 1 tab.

31745 **(IC—87/318) Elastic and anelastic behaviour of icosahedral quasicrystals.** Bolmaro, R.E.; Povolo, F. (International Centre for Theoretical Physics, Trieste (Italy); Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Dept. de Materiales). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702712/JAW.

A theory is developed, based on theoretical-group analysis, which describes the linear, reversible, time-dependent response of an icosahedral quasicrystal, containing point defects, to stress the field known as anelastic relaxation. We obtain also anelastic relaxation relationships for the practical Young, shear and Poisson moduli. (author). 15 refs, 2 figs, 3 tabs.

31746 **(IC—87/325) Influence of local volume forces on surface relaxation of pure metals and alloys: Applications to Ni, Al, Ni_3Al.** Savino, E.J.; Farkas, D. (International Centre for Theoretical Physics, Trieste (Italy); Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702718/JAW.

We present an analysis of the relative influence of the interatomic potential, lattice structure and defect symmetry on the calculated and measured distortion for the free surfaces of alloys and pure metals. In particular, the effect of using local "volume" dependent interactions is studied, as opposed to simple pair interatomic forces. The dependence of the relaxation on the lattice structure is examined by comparing pure metals with ordered alloys. A Green function method for surface relaxation is presented and used for the above analysis as well as for studying the influence of different surface symmetries. Examples based on computer simulation of

Ni, Al and Ni_3Al for some surface orientations are presented. (author). 33 refs, 4 figs.

31747 **(IC—87/331) Green's function approach to roughening transition of one dimensional restricted solid on solid model.** Lin Jiancheng. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702723/JAW.

In this paper by mapping a one dimensional (1D) restricted solid on solid (RSOS) model to a tight binding Hamiltonian (TBH) system, we use Green's function method, a systematical way, to predict roughening transition point for the model with infinite, semi-finite and finite boundaries and with the presence of external attractive pinning potential at any one or two rows. Green's functions for the TBH systems with semi-finite and finite boundaries are derived by an "appending-breaking" way. Phase diagrams which give detailed information about the roughening transition are given in the parameters space. (author). 9 refs, 10 figs.

31748 **(IC—87/335) Effect of surface states on the electrochemical behaviour of single crystal n-ZnSe photoelectrode.** El-Dessouki, M.S. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702726/JAW.

Surface Photovoltage Spectroscopy (SPS) technique has been used to detect the surface states of ZnSe (110) surfaces. Aqueous electrolyte/ZnSe junction has been electrochemically investigated in dark and under illumination. The effect of surface states on the kinetics of charge transfer through the semiconductor-electrolyte (S/E) junction has been discussed. The low leakage and photocurrents measured by the application of DC bias were referred to the blocking nature of S/E interface, in which the localized and induced surface states play an important role. (author). 19 refs, 4 figs.

31749 **(IC—87/337) Influence of the temperature-dependence of recombination life-time of free carriers in amorphous semiconductors on thermostimulated photocurrent spectra.** Xu Zhengyi; Gu Benyuan; Dong Bizhen; Zhu Meifang. (International Centre for Theoretical Physics, Trieste (Italy); Universita "La Sapienza", Rome (Italy); Academia Sinica, Beijing, BJ (China). Inst. of Physics; University of Science and Technology, Beijing, BJ (China). Graduate School). (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702728/JAW.

In previous theoretical analysis of thermostimulated conductivity (TSC) in amorphous semiconductors, for the sake of simplicity, we assumed that the recombination life-time tau of free carriers is a constant independent of temperature. In fact, this assumption is incomplete. The influence of the temperature-dependence of tau on thermostimulated conductivity spectra is investigated in the present work. Under the consideration of T-dependence of tau, all the characteristics of TSC spectra indicated by the previous theoretical analysis still remain valid qualitatively, but the quantitative results are considerably changed. The effect of the relaxation parameters describing the behaviour of tau(T) on the TSC spectra is also discussed. (author). 5 refs, 7 figs.

31750 **(IC—87/339) Vibration spectra induced by impurities in III-V-compounds semiconductors.** Xu Wenlan; Shen, S.C. (Academia Sinica, Shanghai (China). Lab. for Infrared Physics). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702730/JAW.

The vibration spectra induced by different impurities in semiconductor III-V-compounds are discussed. The numerical results for the case of Gallium Phosphide are given and compared with experimental results. (author). 10 refs, 2 figs, 2 tabs.

31751 (INIS-BR—1018, pp 37) **Self-consistent rocking-curve in the Bragg case.** Campos, H.S.; Keller, W.A. (Bahia Univ., Salvador (Brazil). Inst. de Fisica). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

31752 (INIS-BR—1018, pp 38) **Microwave transport properties of highly excited semiconductor plasmas.** Freire, V.N.; Sampaio, A.J.C.; Esperidiao, A.S.C. (Ceara Univ., Fortaleza (Brazil). Dept. de Fisica; Bahia Univ., Salvador (Brazil)). 1987. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW. (CONF-8711187—).

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

31753 **(INIS-SU—18/A) Nonlinear effects in transverse focusing of energized electron flows in bismuth.** Andrievskij, V.V.; Ass, E.I.; Komnik, Yu.F. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1987. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702806/JAW.

Preprint--34-87.

Studies of transverse focusing of electrons in a wide range of injection currents I/sub e/ indicated the existence of two types of nonlinear phenomena. The first type (I/sub e/ <or approx. 100 mA) is characterized by monotonous variations of the focusing peak position and amplitude and is interpreted as the development of "early" geometrical nonlinearity resulting from the essential dependence of the cyclotron radius on the electron energy. The second type (I/sub e/ <or approx. 100 mA) is due to the discrete character of energetic electron-phonon relaxation in a microcontact. The possibility of nonequilibrium electron distribution function spectroscopy by the electron focusing of released energies is shown.

31754 **(IPNO-DRE—8725) Some aspects of MeV heavy ions induced desorption from solid insulating surfaces.** Wien, K.; Della-Negra, S.; Le Beyec, Y.; Monart, B.; Standing, K. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jul 1987. 27p. (CONF-870783—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753072/JAW.

From Radiation effects in insulators-4 conference; Lyon, France (6 Jul 1987).

Various aspects of the secondary ion and electron emission from surfaces of solids bombarded by MeV ion are briefly presented. Two examples of applications in very different fields are given: the charge state variation of a fast ion traversing a solid and the desorption of very large molecules which can be desorbed intact from organic solid films.

31755 **(IS-T—1290) Picosecond excitation transport in disordered systems.** Hart, D.E. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 310p.

Time-resolved fluorescence decay profiles are used to study excitation transport in 2- and 3-dimensional disordered systems. Time-correlated single photon counting detection is used to collect the fluorescence depolarization data. The high signal-to-noise ratios afforded by this technique makes it possible to critically examine current theories of excitation transport. Care has been taken to eliminate or account for the experimental artifacts common to this type of study. Solutions of 3,3'-diethyloxadicarbocyanine iodide (DODCI) in glycerol serve as a radomly distributed array of energy donors in 3-dimensions. A very thin sample cell ({approximately/ 2 μm) is used to minimize the effects of fluorescence self-absorption on the decay kinetics. Evidence of a dynamic shift of the fluorescence spectrum of DODCI in glycerol due to solvent reorganization is presented. The effects of excitation trapping on the decay profiles is minimized in the data analysis procedure. The 3-body theory of Gochanour, Andersen, and Fayer (GAF) and the far less complex 2-particle analytic theory of Huber, Hamilton, and Barnett yield indistinguishable fits to the data over the wide dynamic range of concentrations and decay times studied.

31756 **(IS-T—1291) Picosecond excited state dynamics and excitation transport in solution and on surfaces.** Anfinrud, P.A. (Ames Lab., IA (USA)). Nov 1987. Contract W-7405-ENG-82. 437p.

Time correlated single photon counting was employed in studies of excitation transport (ET) depolarization in 2- and 3-dimensional disordered systems. Reduced concnetrations ranged up to {approximately}3 in ethylene glycol solutions of DODCI (3-dimensioanal system) and {approximately}5 in Langmuir-Blodgett monolayers containing octadecyl rhodamine B (2-dimensional system). Discrepencies between experiment and current ET theories (3-body Gochanour-Andersen-Fayer andor 2-particle Huber) are small when artifacts due to reabsorption, dimerization (and concomitant trapping), solvent reorganization, and molecular reorientation are minimized or correctly modeled. Discrepancies persist in glycerol solutions of DODCI; they are attributed to orientational correlation between chromophores. The orientational correlation apparently arises from 3-dimensional liquid glycerol structure and extends to {approximately}R/sub O/. An optical shot noise limites detection scheme was developed which enabled pump-probe transient absorption studies of submonolayer rhodamine 640 adsorbed on fused silica and ZnO. The ground state recovery dynamics on silica are coverage dependent due to excitation trapping by dye aggregates. In contrast, the recovery on ZnO is significantly faster and essentially coverage independent. This provides strong evidence for efficient dye {yield} semiconductor nonradiative excitation decay.

31757 **(NAC—86-10) Use of silicides for elimination of contact-degradation in shallow-junction silicon devices.** Pretorius, R.; Wandt, M.; Ras, H.A.; Pienaar, A. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1986. 14p. CSIR, National Accelerator Centre, P O Box 72, Faure, South Africa.

By the end of this decade the local micro-electronics industry will be using lateral contact dimensions of less than 2 microns and submicron junction depths. The expertise and experience gained in this project is indispensable to the implementation of such technologies, as silicides will have to be used as metallisation process. This project is thus envisaged as a direct contribution to the development of VLSI metallisation expertise in MOS and bipolar technology. The main purpose of this project is to carry out a detailed study of silicide formation in order to provide the necessary scientific know-how and technological backup for the successful implementation of silicides by the South African micro-electronics industry.

31758 **(UCRL—98431) Laser induced surface emission of neutral species and its relationship to optical surface damage processes.** Chase, L.L.; Smith, L.K. (Lawrence Livermore National Lab., CA (USA)). 2 Mar 1988. Contract W-7405-ENG-48. 37p. (CONF-8710165—11).

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

The laser-induced emission of neutral constituents and impurities from surfaces of several optical materials is shown to be correlated with optical surface damage thresholds. The characteristics of the emission can be utilized to investigate physical processes involved in the absorption of laser energy at the surface. Examples are given of neutral emission correlated with catastrophic surface heating, changes in surface stoichiometry, and thermally-induced cracking. (11 figs.)

31759 **(UCRL—98441) Shock wave compression and metallization of simple molecules.** Ross, M.; Radousky, H.B. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. 40p. (CONF-880372—2).

From NATO advanced study institute on simple molecular systems at very high densities; Les Houches, France (29 Mar 1988).

In this paper we combine shock wave studies and metallization of simple molecules in a single overview. The unifying features are provided by the high shock temperatures which lead to a metallic-like state in the rare gases and to dissociation of diatomic molecules. In the case of the rare gases, electronic excitation into the conduction band leads to a metallic-like inert gas state at lower than metallic densities and provides information regarding the closing of the band gap. Diatomic dissociation caused by thermal excitation also leads to a final metallic-like or monatomic state. Ina ddition, shock wave data can provide information concerning the short range intermolecular force of the insulator that can be useful for calculating the metallic phase transition as for example in the case of hydrogen. 69 refs., 36 figs., 2 tabs.

31760 **Monte Carlo electron backscattering in ZnS and PbS films.** Antolak, A.J.; Williamson W. Jr. (Theoretical Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Applied Physics;* **64**: No. 1, 416-418(1 Jul 1988).

The condensed history Monte Carlo transport code SANd-smcapsy-smcapsL is used to calculate the electron backscattering coefficients and energy distributions for thin ZnS and PbS films. The backscattering coefficients from normally incident 20-, 30-, and 40-keV electrons on various thickness films are compared with experimental data and an empirically derived fitting formula. The agreement between our calculations and the experimental data where available is within 10%. However, for some of the thinnest films, is a somewhat larger discrepancy between the empirical and either the Monte Carlo or experimental results.

31761 **Ultrasonic second-harmonic generation in various crystalline systems: Coupling parameters in terms of elastic moduli and propagation directions.** Gerlich, D.; Breazeale, M.A. (School of Physics and Astronomy, Raymond and Beverly Sackler Faculty of Exact Sciences, Tel Aviv University, Tel Aviv 69978, Israel, and Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996-1200). *Journal of Applied Physics;* **63**: No. 12, 5712-5717(15 Jun 1988).

The ultrasonic second- and third-order coupling parameters, K_2 and K_3, determined by ultrasonic second-harmonic generation, are evaluated in terms of the second- and third-order elastic moduli, for a number of crystalline systems. It is shown that K_2 and K_3 turn out simply to be the values of the elastic moduli C_{11} and C_{111}, transformed into the direction of propagation. The possibility of evaluating the complete set of third-order elastic moduli from measurements of second-harmonic generation and hydrostatic pressure dependence of the sound velocity for pure mode propagation is discussed. Symmetries considered: cubic, hexagonal, rhombohedral, tetragonal, and orthorhombic.

31762 **Localization of multivibrational excitations.** Wartak, M.S.; Yang, L.H.; Fong, C.Y.; Shen, Y.R. (Department of Physics, University of California, Davis, California 95616). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 17, 10350-10352(15 Jun 1988).

We have studied the localization of multivibrational states in the one-dimensional boson system with on-site random anharmonicity. By introducing site basis states (local representation) we were able, in the limit of $\Delta/\text{Gamma-bar} << 1$, where Δ is the coupling interaction between the nearest neighbors and Gamma-bar is the average on-site anharmonic energy, to reduce the problem to Anderson-like model for a one-dimensional electron system with diagonal disorder. Assuming a Cauchy distribution for on-site anharmonicity, we have calculated the degree of localization. It is shown that the degree of localization increases with the increase of the randomness.

31763 **Equilibrium crystal shapes of ideal and random quasicrystals.** Lipowsky, R.; Henley, C.L. (Institut fuer Festkoerperforschung, Kernforschungsanlage Juelich G.m.b.H., 5170 Juelich, West Germany). *Physical Review Letters;* **60**: No. 23, 2394-2397(6 Jun 1988).

The scaling behavior of interfaces is studied for ideal and random quasicrystals in two and three dimensions, and its consequences for the equilibrium crystal shape are discussed. For a 3D decagonal phase, a facet with a fivefold symmetry axis is found to undergo a roughening transition. For a 3D icosahedral phase, such a facet is likely to stay smooth at all temperatures, T, in the ideal case, but is predicted to be rough on sufficiently large scales for $T>0$ in the random case. The singular behavior of the equilibrium crystal shape near the edge of a facet is also determined.

31764 **Calculation of x-ray intensity from a rough sample based on a statistical model.** Hwang, B.; Houska, C.R. (Department of Materials Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). *Journal of Applied Physics;* **63**: No. 11, 5346-5350(1 Jun 1988).

An x-ray intensity correction is developed which begins with a roughness model that is often used to describe real surfaces. This is based upon a normal distribution of surface asperities relative to a mean plane. Pair correlation between absorbing elements along x-ray paths either entering or leaving the sample with respect to the signal producing element is accomplished by means of an exponential autocorrelation function. This allows the degree of roughness to be varied on a local scale to fit specific surfaces using statistical data. Equations are developed to describe x-ray fluorescence and diffraction signals for symmetric and asymmetric beam optics. Theory is compared with experiment using a roughened, fully stabilized zirconia sample.

31765 **Comment on "Exact electron-gas response functions at high density".** Rasolt, M.; Geldart, D.J.W. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **60**: No. 19, 1983-1983(9 May 1988).

A Comment on the Letter by D. C. Langreth and S. H. Vosko, Phys. Rev. Lett. 59, 497 (1987).

31766 **Modified asymptotic approach to modeling a dilute-binary-alloy solidification front.** Hyman, J.M.; Novick-Cohen, A.; Rosenau, P. (Center for Nonlinear Studies, Theoretical Division, MS B284, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **37**: No. 13, 7603-7608(1 May 1988). Contract W-7405-ENG-36.

Directional solidification in the presence of an impurity may be described by a set of impurity-concentration and thermal-diffusion equations coupled at a free boundary. Small deviations of the interface from planarity can be described by a single fourth-order equation. This equation is derived by a long-wavelength, small-amplitude expansion in the limit of a small distribution coefficient. We present an alternative asymptotic approach that isolates and preserves the crucially important nonlinearities in their original form, and thus preserves the proper behavior at large amplitudes during pattern formation. The resulting evolution equation is in better agreement with the physical phenomena of front destabilization and droplet creation than are previously presented models. The formation of different solidification patterns is numerically elucidated.

31767 **Low-temperature expansions for an Ising model on a hexagonal-close-packed lattice with competing interactions.** Zimmerman, D.S.; Kallin, C.; Berlinsky, A.J. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6030). *Physical Review [Section] B: Condensed Matter;* **37**: No. 13, 7766-7776(1 May 1988). Contract AC05-84OR21400.

The limit of stability for the ferromagnetic phase of an hcp Ising model with in-plane antiferromagnetic interactions, J, and out-of-plane ferromagnetic interactions, D, is calculated with use of a low-temperature expansion. To the lowest order in $x = \exp(-2D/T)$ the limit of stability is given by $y = 1-x$, where $y = \exp[-4(1/2+J/D)/T]$. The calculation to order x^2 requires the summation of excitations which contribute to the free-energy terms proportional to arbitrary powers of x and y, but when summed, contribute to order x^2, along the line $y = 1-x$. The resulting limit of stability for the ferromagnetic phase coincides to order x^2, with the special line onto which Domany mapped a dynamical ferromagnetic Ising model on the honeycomb lattice. This strongly suggests that part of this special line exactly coincides with the ferromagnetic phase boundary.

31768 **Successive magnetic phase transitions in tetragonal $YBa_2Cu_3O_6\mu$/sub x/.** Kadowaki, H.; Nishi, M.; Yamada, Y.; Takeya, H.; Takei, H.; Shapiro, S.M.; Shirane, G. (The Institute for Solid State Physics, The University of Tokyo, Roppongi, Minato-ku, Tokyo 106, Japan). *Physical Review [Section] B: Condensed Matter;* **37**: No. 13, 7932-7935(1 May 1988).

Neutron diffraction experiments on a tetragonal single crystal of $YBa_2Cu_3O_6\mu$/sub x/ (with $x \sim 0.35$) reveal a second magnetic phase transition associated with appearance of superlattice peaks at (12 12l)(l = half-integer)= at about 40 K, which is well below the Neel temperature 405 +- 5 K. This transition is associated with the ordering of the Cu^{2+} moments on the oxygen-deficient layers. The observed magnetic intensities at 9 K are consistent with ground-state spin configurations of a model which takes account of frustration.

31769 **Computer simulation results for the two-point probability function of composite media.** Smith, P. (Department of Mechanical and Aerospace Engineering, North Carolina State University, Raleigh, North Carolina 27695-7910). *Journal of Computational Physics;* **76**: No. 1, 176-191(May 1988).

Computer simulation results are reported for the two-point matrix probability function S_2 of two-phase random media composed of disks distributed with an arbitrary degree of impenetrability λ. The novel technique employed to sample $S_2(r)$ (which gives the probability of finding the endpoints of a line segment of length r in the matrix) is very accurate and has a fast execution time. Results for the limiting cases $\lambda = 0$ (fully penetrable disks) and $\lambda = 1$ (hard disks), respectively, compare very favorably with theoretical predictions made by Torquato and Beasley and by Torquato and Lado. Results are also reported for several values of λ that lie between these two extremes; cases which heretofore have not been examined. copyright 1988 Academic Press, Inc.

31770 **Rotational dynamics and electronic energy partitioning in the electron-stimulated desorption of NO from Pt(111).** Burns, A.R.; Stechel, E.B.; Jennison, D.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 895-898(May 1988).

Using laser resonance ionization, we have examined the rotational dynamics of neutral NO molecules desorbed by electron impact from a cold (80 K) Pt(111)= surface. Previously [A. R. Burns, E. B. Stechel, and D. R. Jennison, Phys. Rev. Lett. 58, 250 (1987)], we observed "hot" rotational temperatures in the range 481—642 K for the $\nu = 0$, 1, 2, and 3 vibrational levels. We now present more detailed data which do not reveal shifts or broadening in the rotationally selected NO velocity distributions as a function of rotational level J in the range $J = 2.5$—29.5. The rotationally independent velocity distributions, peaked at 0.05 eV, as well as the rotational temperature can be understood within the framework of "electronically stimulated adsorbate rotation" (Burns et al., above). The model also predicts complete rotational alignment in a plane normal to the surface. In the laboratory, no alignment is observed, but this is most likely due to the presence of stray magnetic fields. We will also discuss our measurements which show an equal partitioning between the two lowest NO electronic states ($^2\Pi_{1/2}$ and $^2\Pi_{3/2}$), and a preference for the π level which is perpendicular (antisymmetric) to the plane of rotation.

31771 **Ion beam self-sputtering using a cathodic arc ion source.** Sanders, D.M. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1929-1933(May 1988).

A low-voltage/high-current vacuum arc offers a means of producing high-current ion beams. These beams can be employed in conjunction with suitable anode and sputter target configurations to permit coating production by self-sputtering without the necessity for adding process gas. This paper describes the influence of sputtering angle and target voltage on coating rate and morphology.

31772 **Depth of origin of sputtered atoms: Experimental and theoretical study of Cu/Ru(0001).** Burnett, J.W.; Biersack, J.P.; Gruen, D.M.; Joergensen, B.; Krauss, A.R.; Pellin, M.J.; Schweitzer, E.L.; Yates J.T. Jr.; Young, C.E. (Pittsburgh Surface Science Center, University of Pittsburgh, Pittsburgh, Pennsylvania 15260). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 2064-2068(May 1988).

The depth of origin of sputtered atoms is a subject of considerable interest. The surface sensitivity of analytical techniques such as secondary ion mass spectrometry and surface analysis by resonance ionization of sputtered atoms (SARISA), and the sputtering properties of strongly segregating alloy systems, are critically dependent on the sputtering depth of origin. A significant discrepancy exists between the predictions of existing analytical sputtering theories and computer sputtering models; in general, the computer models predict a much shallower depth of origin. The existing experimental evidence suggests that most of the sputtered atoms originate in the topmost atomic layer, but until recently, the results have not been definitive. We have experimentally determined the depth of origin of atoms sputtered from surfaces consisting of Cu films of <2 monolayers on a Ru(0001) substrate. The Cu/Ru target was statically sputtered using 3.6-keV Ar^+. The sputtered neutrals were nonresonantly laser ionized and detected using SARISA. The Cu/Ru sputtering yield ratio and the suppression of the Ru sputtering yield were determined for various Cu coverages. The results indicate that the majority of the sputtered atoms originate in the topmost atomic layer. The Cu/Ru system is also modeled using a modified transport of ions in matter (t-smcapsr-smcapsIm-smcaps) code. It was found that t-smcapsr-smcapsIm-smcaps -smcapsc-smcaps does not correctly treat the first atomic layer, resulting in a serious underestimate of the number of sputtered atoms which originate in this layer. The corrected version adequately describes the results, predicting that for the experimental conditions roughly two-thirds of the sputtered atoms originate in the first atomic layer.

31773 **Helium-ion-induced release of hydrogen from graphite.** Langley, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 2119-2121(May 1988).

The ion-induced release of hydrogen from AXF-5Q graphite was studied for 350-eV helium ions. The hydrogen was implanted into the graphite with a low energy (~200 eV) and to a high fluence. This achieved a thin (~10-nm), saturated near-surface region. The release of hydrogen was measured as a function of helium fluence. A model that includes ion-induced detrapping, retrapping, and surface recombination was used to analyze the experimental data. A value of (1.65 +- 0.2) x 10^{-16} cm^2 was obtained for the detrapping cross section, and a value of (0.5—4) x 10^{-14} cm^4 s was obtained for the recombination coefficient.

31774 **Simulations without critical slowing down.** Kandel, D.; Domany, E.; Ron, D.; Brandt, A.; Loh E. Jr. (Department of Electronics, Weizmann Institute of Science, Rehovot, 76100 Israel). *Physical Review Letters;* 60: No. 16, 1591-1594(18 Apr 1988).

We have developed a novel simulation method that combines a multigrid technique with a stochastic blocking procedure. Our algorithm eliminates critical slowing down completely, as demonstrated by simulations of the two-dimensional Ising model at criticality.

31775 **Heavy-fermion system: An exact many-body solution to a periodic-cluster Hubbard model.** Reich, A.;Falicov, L.M. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 10, 5560-5570(1 Apr 1988). Contract AC03-76SF00098.

An exact solution of an eight-site crystal model with periodic boundary conditions, a small face-centered-cubic crystal, is presented for the case of a heavy-fermion system. The model consists of (a) a single, fully symmetric orbital per site, with nearest-neighbor and second-nearest-neighbor hopping, (b) an infinite Coulomb repulsion between electrons on the same site, (c) antiferromagnetic superexchange interactions, and (d) a nearly-half-filled band ((7/8 electron per site). Application of group-theoretical techniques yields a set of energies which are at most (analytic) solutions of quadratic equations. Depending on the sign of the nearest-neighbor hopping parameter the ground state exhibits either a huge accidental degeneracy (the heavy-fermion case), or simple, uniform, saturated itinerant ferromagnetism. The model is, at once, easy to handle and yet rich in structure. Fermi-surface, spin-wave, and electron-transport properties are investigated, and consequences for real systems discussed.

31776 **Excimer formation as the relaxation of a nonlinear oscillator: Theory of Y states.** Dunlap, D.H.;Kenkre, V.M. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 9, 4390-4398(15 Mar 1988).

The existence of Y states in excimer-forming molecular crystals is addressed through a simple extension of an earlier model of the formation of excimers as occurring through the relaxation of a nonlinear oscillator. These Y states, which do not appear in solution, and have been observed in only some crystals, are intermediate states with partial excimeric character. Such states are shown to arise naturally in our model as a simple consequence of additional interactions that exist in the crystal, but not in solution, and to be associated with an abrupt (rather than gradual) transition as the strength of those interactions is varied.

31777 **Analytic nearest-neighbor model for fcc metals.** Johnson, R.A. (Department of Materials Science, University of Virginia, Thornton Hall, Charlottesville, Virginia 22901). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 8, 3924-3931(15 Mar 1988).

The implications of the mathematical format of the embedded-atom method of computer modeling of metals have been studied with use of a simple nearest-neighbor analytic model for the fcc lattice. The physical inputs into the model are the atomic volume, the cohesive energy, the bulk modulus, the average shear modulus, the vacancy-formation energy, and the slope at the nearest-neighbor distance of the spherically averaged free-atom electron density calculated with Hartree-Fock theory. The model employs an exponential repulsion between nearest-neighboring atoms, an exponentially decreasing function for the free-atom electron density, and a universal equation relating the crystal energy and the lattice constant. The anisotropy ratio of the cubic shear moduli is constrained to be 2 with this model. The dependence of the energies for unrelaxed configurations for vacancy formation, divacancy binding, and low-index plane surfaces on the model parameters has been analyzed. The average shear modulus plays a dominant role in determining these energies relative to the bulk modulus or the cohesive energy because the slope of the embedding function at the equilibrium electron density is linear in the average shear modulus. Embedding functions are not uniquely determined in specific models, and it is shown that the embedding functions used in several models are essentially equivalent.

31778 **Continuum studies of magnetic polarons and bipolarons in antiferromagnets.** Emin, D.;Hillery, M.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* 37: No. 8, 4060-4070(15 Mar 1988). Contract AC04-76DP00789.

We present a simple scaling model of magnetic-polaron and magnetic-bipolaron formation in antiferromagnetic systems. Within this picture, we determine the criteria for an excess electron forming a magnetic polaron and for a pair of excess electrons forming a (triplet) magnetic bipolaron. The dependence of the formation criteria on the dimensionality of the electronic system is specifically addressed. In addition, we consider the effect of the electron-lattice interaction on the size and energetic stability of magnetic polarons and bipolarons as a function of the system's dimensionality. Beyond the formation of isolated magnetic polarons and/or magnetic bipolarons, we consider how a system composed of magnetic polarons within an antiferromagnetic system is driven ferromagnetic as the density of magnetic polarons is increased. Finally, we discuss the large paramagnetic susceptibility associated with the formation of magnetic polarons. The magnetic susceptibility is composed of a

Curie-like temperature-dependent component as well as a temperature-independent component. The temperature-dependent term arises from the reorienting of the magnetic polarons under the influence of a magnetic field. The temperature-independent contribution arises from the expansion and contraction of magnetic polarons which are, respectively, aligned parallel or antiparallel with the applied magnetic field.

31779 Structure and electronic properties of Thue-Morse lattices. Cheng, Z.;Savit, R.;Merlin, R. (Department of Physics, University of Michigan, Ann Arbor, Michigan, 48109-1120). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 9, 4375-4382(15 Mar 1988).

We study a one-dimensional system which is neither periodic, quasiperiodic, nor random. We find that the structure factor of this system consists of a set of peaks whose heights scale with L, the length of the chain, according to L/sup α//sup (//sup k//sup)/. We show that for k<(12, $\alpha(k) \leq \alpha((13) = \ln 3 / \ln 2$, so that all of the peaks vanish relative to the peak at the center of the Brillouin zone (which is associated with the periodicity of the underlying lattice) as the system grows. We also prove a number of other properties of these exponents. We discuss the energy spectrum of this system for both weak and strong potentials. We show how the gaps in the two limits are related, and we argue that, despite the expectations of naive perturbation theory, gaps persist in the $L \to \infty$ limit.

31780 Fourier-transform method for accurate analysis of Moessbauer spectra. Mullen, J.G.;Djedid, A.;Schupp, G.;Cowan, D.;Cao, Y.;Crow, M.L.;Yelon, W.B. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 7, 3226-3245(1 Mar 1988).

We report a simple analytic form for the convolution integral in transmission Moessbauer spectroscopy allowing accurate representation of the line shape even for very thick absorbers (t = 10), and permitting easy fitting to the true line-shape function. This representation permits the accurate determination of all Moessbauer-effect (ME) parameters, including position, width, cross section, and interference. This analytic method can be applied to deconvolute accurately information contained in either source or absorber, and an explicit analytic form for the emission and absorption Fourier transforms is given. We show that from the asymptotics of the line shape, it is possible to determine all line-shape parameters, and that line-shape asymptotics can circumvent short-ranged hyperfine or instrumental broadening contributions to the observed spectrum. A formula for the correction to the line shape caused by source self-absorption is given, and it is shown that when there is significant source resonance self-absorption a "good" fit to data, judged by a chi-squared analysis, can yield completely wrong ME line-shape parameters. We find an equation for the dependence of the area under the absorption curve and the resonance peak height, and give its explicit dependence on the interference parameter and source broadening parameters. Although these effects have been neglected in earlier work, their contribution may be of order 10% in many cases of interest.

31781 Electron polaron effects in heavy-electron systems. Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6032). *Physical Review* [*Section*] *B: Condensed Matter;* **37**: No. 7, 3542-3551(1 Mar 1988). Contract AC05-84OR21400.

Heavy-electron materials exhibit Fermi-liquid behavior at low temperatures and single-site spin-fluctuation behavior at high temperatures. There is strong experimental evidence that the fermion excitations at low temperatures are itinerant f electrons. It is shown in this paper that the Coulomb correlation between an f hole and the conduction-band electrons causes the f electrons to propagate like small polarons in insulators and semiconductors, and the accompanying screening cloud is formed by broadband electrons. At elevated temperatures the polaron is increasingly attenuated that it gradually becomes localized. This mechanism may explain many anomalous properties of heavy-electron materials up to the crossover temperature, suggesting that the crossover could be driven by the polaron effect.

31782 (UCRL-Trans—12208) Nephelauxetic effect for 4f/sup N/ configurations in the solid phase. Caro, P.; Beaury, D.; Antic, E. Translated from *Journal de Physiue (Les Ulis) ;* **37**: 671-676(Jun 1976). Contract W-7405-ENG-48. 13p.

The change in energy of the levels $^2P_1 2(4f^2)$, $^5D_0)4f^6)$ and $^6P_7 2(4f^7)$ was recorded after doping of the corresponding elements in isomorphous, or structurally related matrices across the lanthanide series. It is shown, that when a 4f/sup N/ ion is introduced into a solid, the Racah parpmeters E_1, E_2, E_3 are reduced as the lanthanide to ligand distance is made smaller, for the same crystalline geometry. The respective percentages of reduction for each of the three parameters are unequal and depend on the nature of the crystal structure. 11 refs., 4 figs., 1 tab.

6561 Superconductivity

REFER ALSO TO CITATION(S) 30600, 30601, 30602, 30603, 30604, 30609, 30610, 30612, 30621, 30623, 30627, 30628, 30630, 30631, 30632, 31438, 31768

31783 (AD-A—189353/6/XAB) Superconductors with structured surfaces. Fields and currents. Technical report. Wu, Z.C.; Jelski, D.A.; George, T.F. (State Univ. of New York, Buffalo (USA). Dept. of Chemistry). Dec 1987. 13p. (UBUFFALO/DC—87/TR-62). NTIS, PC A03/MF A01.

This paper discusses the behavior of currents and fields along a structured superconductor. First the effect of surface structure on supercurrents is investigated. Then the effect of structure on the critical nucleation field is discussed in two cases, one with the magnetic field parallel to the ripples and the other with the field parallel to the grating wavenumber. In the first case, it is found that the critical field is reduced as a function of grating height, whereas in the latter case it is increased. Finally, the relevance of this work for laser-induced chemistry above a superconducting surface is discussed. The Ginzburg-Landau model is used throughout.

31784 (IC—87/280) Phenomenological approach to the coexistence of planar antiferromagnetism with high T/sub c/ type II superconductivity. Chela Flores, J.; Saif, A.G.; Shehata, L.N. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702684/JAW.

A phenomenological study in d-spatial dimensions is presented for the coexistence of planar antiferromagnetism and type II superconductivity. In this approach critical temperatures in the range 30-100 K arise due to the proposed coupling of magnons and conduction electron-pairs. We discuss some remarkable features of oxide ceramics, including a longer London penetration depth, shorter coherence length, lower H/sub c1/, higher H/sub c2/, large current densities, and large pinning force. (author). 45 refs, 3 figs.

31785 (IC—87/298) Magnetostatics of anisotropic superconducting ellipsoid. Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702698/JAW.

The magnetization and the magnetic field distribution inside (outside) an anisotropic type II superconducting ellipsoid, with filamentary structure, is formulated. We have shown that the magnetic field in this case is different from that of the general anisotropic one. The nucleations of the flux lines for specimens with large demagnetization factors are theoretically studied. We have shown that the nucleations of the flux lines, for specimens with large demagnetization factor, appears at a field larger than that of ellipsoidal shape. (author). 15 refs.

31786 (IC—87/309) Behaviour and hysteresis losses of irreversible type-II superconducting cylindrical shell. Saif, A.G. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702708/JAW.

The internal magnetic field distribution in a type-II superconducting cylindrical shell is determined. The superheating - and

the supercooling - fields are developed. We have shown the effect of a transport current on the creation and annihilating of the potential barrier for high H-cylindrical shell. The ac losses are studied in the frame of the general critical state theory. For high T/sub c/ superconducting sample, we get a smaller superheating - and supercooling - fields than that for conventional superconductors. (author). 9 refs, 1 fig, 2 tabs.

31787 (INIS-SU—17/A) Electronic transfer of local pairs in crystals and superconductivity in metal oxide complexes. Kulik, I.O. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702805/JAW.

Preprint--23-87.

Hybridization of two-electron centers (local electronic pairs) with the conduction electrons in crystals results in universal mechanism of the interaction between pairs. The latter provides indirect transfer of pairs, between their localization sites, even in case of nonoverlapping wave functions of pairs. The transition to the pair-correlated state is shown to be of "superconducting glass" type. If the position of pair energy level, per one electron, is above Fermi level of a metal, or of this level is positioned within the gap region near the top of the filled band, the possibility of "reentrant" high temperatures superconductivity arises.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 31574, 31579, 31605, 31876

31788 (AD-A—189342/9/XAB) Stochastic-evolution equations driven by nuclear-space-valued martingales. Technical report, 1 October 1986-30 September 1987. Kallianpur, G.; Perez-Abreu, V. (North Carolina Univ., Chapel Hill (USA). Center for Stochastic Precesses). Sep 1987. 59p. (TR—204). NTIS, PC A04/MF A01.

This paper presents a theory of stochastic-evolution equations for nuclear-space-valued processes and provides a unified treatment of several examples from the field of applications. (C/sub 0,1/) reversed evolution systems on countably Hilbertian nuclear spaces are also investigated.

31789 (AD-A—189746/1/XAB) High-speed transcendental elementary-function architecture in support of the Vector Wave Equation (VWE). Master's thesis. Bailey, M.J. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 93p. (AFIT/GE/ENG—87D-3). NTIS, PC A05/MF A01.

In support of a Very High Speed Integrated Circuit (VHSIC) class processor for computation of a set of equations known as the Vector Wave Equations (VWE), certain elementary functions including sine, cosine, and division are required. These elementary functions are the bottlenecks in the VWE processor. Floating-point multipliers and adders comprise the remainder of the pipeline stages in the VWE processor. To speed up the computation of the elementary functions, pipelining within the functions is considered. To compute sine, cosine, and division, the CORDIC algorithm is presented. Another method for computation of sine and cosine is the expansion of the Chebyshev polynomials. The equations for the CORDIC processor are recursive and the resulting hardware is very simple, consisting of three adders, three shifters, and lookup table for some of the coefficients. The shifters replace the multiplies, because in binary, i right shifts is the same as multiplying by 2 to the 8th power. The expansion of the Chebyshev polynomials can be used to compute other trigonometric functions as well as the exponential and logarithmic functions. The expansion of the Chebyshev polynomials can be used as a mathematic coprocessor. From these equations, a pipelined architecture can be realized that results in very fast computation times. The transformation of these equations as a function of x instead of the Chebyshev polynomials produces an architecture that requires less hardware, resulting in even faster computation times.

31790 (AD-A—189852/7/XAB) Quantum theory of atomic fluorescence near a metal surface. Arnoldus, H.F.; George, T.F. (State Univ. of New York, Buffalo (USA)). 15 Oct 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. of Chemical Physics, Vol. 87, No. 8, 4263-4272(15 Oct 1987).

Quantum electrodynamics of an atom near a surface is a timely problem in current theoretical research. It appears, however, that a full dynamical theory, which includes both the time evolution of the atomic density operator and the details of the fluorescence radiation (temporal photon distribution) has never been formulated. In this paper the quantum theory of an atom near a perfect conductor is presented, and it is indicated how the formalism can be modified to account for more realistic optically-active substrates. An expression is derived for the atomic spontaneous-decay Liouville operator from the Hamiltonian, which recovers the familiar results for the lifetimes and energy shifts. Furthermore, the emitted power is calculated as a function of time from the explicit expression for the radiation field. Comparison of the atomic-decay rates with the power of the emitted radiation shows the consistency of the theory, as far as the properties of the fluorescence are concerned. An unusual energy interference in the fluorescence, which is emitted by a multilevel atom, is predicted. Similarities and discrepancies with other theories are pointed out, and it is shown that especially the mirror theory has a very restricted applicability.

31791 (CONF-880601—3) Five-point form of the nodal diffusion method and comparison with finite-difference. Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

Nodal Methods have been derived, implemented and numerically tested for several problems in physics and engineering. In the field of nuclear engineering, many nodal formalisms have been used for the neutron diffusion equation, all yielding results which were far more computationally efficient than conventional Finite Difference (FD) and Finite Element (FE) methods. However, not much effort has been devoted to theoretically comparing nodal and FD methods in order to explain the very high accuracy of the former. In this summary we outline the derivation of a simple five-point form for the lowest order nodal method and compare it to the traditional five-point, edge-centered FD scheme. The effect of the observed differences on the accuracy of the respective methods is established by considering a simple test problem. It must be emphasized that the nodal five-point scheme derived here is mathematically equivalent to previously derived lowest order nodal methods. 7 refs., 1 tab.

31792 (DOE/ER/13243—4) Multilevel relaxation phenomena and population trapping: [Progress report], July 1, 1987-June 30, 1988. Hioe, F.T. (Saint John Fisher Coll., Rochester, NY (USA)). Mar 1988. Contract FG02-84ER13243. 5p.

This report summarizes the new results obtained in the last eight months from July 1, 1987 and the research work in progress. Our work deals with various aspects of a multilevel quantum system interacting with an intense laser field. We have obtained analytically constants of evolution under various experimental conditions, as well as conditions for complete transfer of the population from the ground state to any one of the excited states. 9 refs.

31793 (DOE/ET/53088—317) Exact area devil's staircase for the sawtooth map. Chen, Q.; Meiss, J.D. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Apr 1988. Contract FG05-80ET53088. 18p. (IFSR—317).

The sawtooth mapping is a family of uniformly hyperbolic, piecewise linear, area-preserving maps on the cylinder. We construct the resonances, cantori, and turnstiles of this family and derive exact formulas for the resonance areas and the escaping fluxes. These are of prime interst for an understanding of the deterministic transport which occurs the stochastic regime. The resonances are shown to fill the full measure of phase space. 9 refs., 4 figs.

31794 **(IC—87/168) Passage of relativistic magnetic dipole moments through magnetic fields.** Barut, A.O.; Bozic, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702640/JAW.

We have solved the Dirac equation with an anomalous moment Pauli-coupling exactly for a constant magnetic field and derived the general relativistic formulas for phase changes due to translational motion and spin rotations. We also give transmission and reflection coefficients, spin rotation for tunnelling and barrier penetration. For ultrarelativistic particles the spin rotation angle on the path of length L is equal to $(2\mu B\ L(h2\pi)c)\ (1+m^2c^4(E^2-\mu^2B^2))$. (author). 13 refs, 4 figs.

31795 **(IC—87/187) Can we calculate the fundamental dimensionless constants of physics.** Barut, A.O. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702641/JAW.

We review some dynamical models to calculate the dimensionless constants $\alpha=e^2/4\pi\epsilon_0(h2\pi)c$, $\beta=M/sub\ p/m/sub\ e/$ (or $\beta'=m/sub\ \mu/m/sub\ e/$), $\gamma=G/sub\ Fermi/\ m/sub\ e/^2c(h2\pi)^3$ and $\delta=G/sub\ Newton/\ m/sub\ e/^2(e^2/4\pi\epsilon_0)$ which are associated with the four different manifestations (electromagnetic, strong, weak and gravitational) of a possible single interaction. (author). 15 refs.

31796 **(IC—87/189) On the GKP and BS constructions of c-boundary.** Kuang Zhiquan; Liang Canbin. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702643/JAW.

Two examples are presented in this paper, the first is unfavorable to the c-boundary construction given by Geroch, Kronheimer and Penrose but in favor of that given by Budic and Sachs, while the second plays an opposite role. The second example is also an example of a causally continuous spacetime with a "really big gap", contrary to what was believed in the literature. (author). 10 refs.

31797 **(IC—87/193) Regularity of solutions for nonlinear degenerate elliptic boundary value problems.** Hong Jiaxing. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702646/JAW.

In the present paper, with the aid of the techniques of microlocal analysis, a regularity theorem of the solutions to Dirichlet problem for a class of nonlinear degenerate elliptic equations is given. (author). 8 refs.

31798 **(IC—87/195) Position operator revisited.** Bacry, H. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702648/JAW.

A position operator is proposed for any kind of particle. The components of this operator are non-commuting for spinning particles. The advantages of such an operator are examined. (author). 10 refs.

31799 **(IC—87/227) On the reduction of symmetry for static flat space-time in some general cylindrical-like coordinates.** Bokhari, A.H.; Bokhari, N.A. (International Centre for Theoretical Physics, Trieste (Italy); F.G. Margala Coll. for Women, Islamabad (Pakistan)). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702663/JAW.

Flat static metric in terms of general cylindrical-like coordinates is considered and symmetry is reduced step by step. It turns out that the maximal and the minimal symmetry remains the same as that of the Minkowski or the Schwarzschild type. As soon as the dimensions of the metric are reduced, the symmetry turns out to be 6 or 3 in terms of independent Killing vector fields, respectively, not yet filling all the gaps between 10 to 8 to 4 or from 10 to 8 to 6 to 4 to 3 to 1. (author). 8 refs.

31800 **(IC—87/235) Some remarks on geodesics in gauge groups and harmonic maps.** Valli, G. (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702665/JAW.

The following topics are discussed: Euler's equations for geodesics in the gauge groups and in gauge orbits of connections, conserved quantities and moment map, existence and uniqueness of solutions for the Cauchy problem, stationary solutions and harmonic bundles, harmonic gauges on Riemann surfaces and Lax pairs, low geodesics in gauge groups over Riemann surfaces produce, by Hodge decomposition, paths of holomorphic differentials. 19 refs.

31801 **(IC—87/237) Compactness of imbedding of Sobolev spaces.** Duong Minh Duc; Le Dung. (International Centre for Theoretical Physics, Trieste (Italy); Hochiminh City Univ. (Viet Nam). Dept. of Mathematics). (International Centre for Theoretical Physics, Trieste (Italy)). Aug 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702667/JAW.

We prove a Poincare inequality for functions vanishing on a part of the boundary of their domain. Using this inequality we study the compactness of imbedding of weighted Sobolev spaces. Some concrete examples are given. (author). 10 refs.

31802 **(IC—87/269) New reduction formulas for Lauricella function F/sub A/ and Appell function F_2.** Mojumder, M.A. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702673/JAW.

We have found a new formal representation of F/sub A/ as a binomial series from which we have derived new reduction formulas for the functions F/sub A/ and F_2. (author). 5 refs.

31803 **(IC—87/275) Electromagnetic interactions in relativistic systems of many bodies.** Cook, A.H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702679/JAW.

In a previous report (Cook, 1986, 1987) on a formulation of a quasi-relativistic quantum mechanical equation of motion for many particles, little was said of the electromagnetic interactions that keep a set of particles in a bound state. That omission is to some extent repaired in this report. (author). 3 refs.

31804 **(IC—87/276) Symmetry and separation of Dirac's operator and its extension.** Cook, A.H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88702680/JAW.

An earlier discussion (Cook, 1982) of the separation of Dirac's equation for the electron is reconsidered and extended in terms of the symmetry operations admitted by Dirac's operator. The reason for the limited possibilities of separation are clarified, as is the relation of the spin operator to the choice of the reference vierbein for the spinors. The discussion is extended to an equation for many bodies (Cook, 1986, 1987). (author). 9 refs.

31805 **(IC—87/277) On the basis of molecular orbitals for relativistic bound systems of many bodies.** Cook, A.H. (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702681/JAW.

The quasi-relativistic Hamiltonian for bound states of many bodies proposed in previous articles (Cook, 1986, 1987a) is shown to provide a basis for the molecular orbital scheme of constructing wavefunctions and calculating eigenenergies. (author). 5 refs.

31806 **(IC—87/312) Galilei-Newton law by symplectic realizations.** Nzotungicimpaye, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702709/JAW.

We classify all the coadjoint orbits of the central extension G-circumflex of the one spatial dimensional Galilei group G.

Taking them as support of the generic symplectic realizations of the Galilei group G, we give their possible physical interpretations and we find that mass and force have their origin in the cohomological theory of the Galilei group. (author). 10 refs, 1 tab.

31807 **(IC—87/317) Singularities in the nonisotropic Boltzmann equation.** Garibotti, C.R.; Martiarena, M.L.; Zanette, D. (International Centre for Theoretical Physics, Trieste (Italy); Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche). (International Centre for Theoretical Physics, Trieste (Italy)). Sep 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702711/JAW.

We consider solutions of the nonlinear Boltzmann equation (NLBE) with anisotropic singular initial conditions, which give a simplified model for the penetration of a monochromatic beam on a rarified target. The NLBE is transformed into an integral equation which is solved iteratively and the evolution of the initial singularities is discussed. (author). 5 refs.

31808 **(IC—87/344) Critical values of functionals on Banach surfaces.** Duong Minh Duc. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702735/JAW.

In this paper we define the directional differentiability along a dense linear subspace D of a Banach space E and study the critical values of D-differentiable functionals on surfaces in E. (author). 11 refs.

31809 **(IC—87/353) Remark on the global existence for the generalized Benjamin-Bona-Mahony equations in arbitrary dimension.** Chen Yunmei. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702739/JAW.

In this paper, the global existence of the solutions to the initial boundary value problems of GBBM equations in arbitrary dimension d is further studied. It is proved that when the nonlinear function satisfies some polynomial-like growth bounds, there exists a unique global solution in the space C((O, ∞); W/sup 2,p/(G) intersection W/sup 1,p/(G)), with max(1,d2) < p < ∞. (author). 6 refs.

31810 **(IC—87/357) Matching with transfer matrices.** Perez-Alvarez, R.; Velasco, V.R.; Garcia-Moliner, F.; Rodriguez-Coppola, H. (International Centre for Theoretical Physics, Trieste (Italy); La Habana Univ. (Cuba). Dept. de Fisica Teorica). (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702740/JAW.

An ABC configuration - which corresponds to various systems of physical interest, such as a barrier or a quantum well - is studied by combining a surface Green function matching analysis of the entire system with a description of the intermediate (B) region in terms of a transfer matrix in the sense of Mora et al. (1985). This hybrid approach proves very useful when it is very difficult to construct the corresponding Green function G/sub B/. An application is made to the calculation of quantised subband levels in a parabolic quantum well. Further possibilities of extension of this approach are pointed out. (author). 27 refs, 1 tab.

31811 **(IFUSP-P—636) Bifurcations of periodic solutions of non-integrable Hamiltonians with two degrees of freedom: numerical and analytical results.** Aguiar, M.A.M. de; Malta, C.P.; Baranger, M.; Davies, K.T.R. (Sao Paulo Univ. (Brazil). Inst. de Fisica; Massachussits Inst. of Tech., Cambridge (USA); Oak Ridge National Lab., TN (USA)). (Sao Paulo Univ. (Brazil). Inst. de Fisica). Apr 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702747/JAW.

An analytical study of the bifurcations of periodic solutions observed numerically in a two-dimensional non-integrable Hamiltonian system with two degrees of freedom is presented.

31812 **(INIS-BR—1018) Proceedings of the 5. Meeting of Physicists from Northeast-Abstracts.** (Rio Grande do Norte Univ., Natal (Brazil). Dept. de Fisica). 1987. 66p. (In Portuguese). (CONF-8711187—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88702601/JAW.

From 5. meeting of physicists from northeast; Natal, Brazil (12 Nov 1987).

The researches developed in several Universities at Northeastern Brazil in the fields of material science, nuclear physics, particles, field teories and mathematical physics, are presented. (M.C.K.).

31813 **(INIS-SU—20/A) Dynamics of dark solitons of nonzero vacuum in a onecomponent system.** Kovalev, A.S.; Kulagin, N.E. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur). 1987. 23p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702808/JAW.

Preprint--14-87.

The example of the Sh-Gordon equation is used to consider the dynamics of solitons in one-component systems with "hard" nonlinearity. It is shown that nonsingular localized solutions exist only against the background of nonzero vacuum (condensate). These excitations represent "dark" one-parameter solitons (holes on condensate). The structure and dynamic properties of such excitations are studied. The soliton velocity is found as a function of the condensate density and the phase shift of the condensate during soliton motion. Quantitative analysis suggests uniqueness of such localized solutions.

31814 **(LA-UR—88-915) Eigenmodes of a random walk on a 2-D lattice torus with one trap.** Torney, D.C. (Los Alamos National Lab., NM (USA)). 14 Mar 1988. Contract W-7405-ENG-36. 15p. (CONF-880123—2).

From Conference on transport theory, invariant imbedding and integral equations; Santa Fe, NM, USA (20 Jan 1988).

The complete set of eigenvalues and eigenmodes is elaborated for a random walk on a two-dimensional N {times} N square lattice torus with one trap site. The eigenvalue closest to unity is found to have an asymptotic expansion in N; the leading behavior is λ {approximately} 1 {minus} π (2N^2 log N) {plus} O(N log N)/sup {minus/2}. In general, the eigenvalues and eigenmodes for this problem are constructed from those for a random walk on the same lattice containing no trap. The degeneracy of the latter eigenmodes is a prominent feature of this construction, and a formula is derived for this degeneracy. 9 refs., 2 figs.

31815 **(LA-UR—88-926) Quantum gravity and new forces.** Hughes, R.J.;Goldman, T.;Nieto, M.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880173—1).

From 22. Moriond workshop on neutrinos and exotic phenomena in particle physics and astrophysics; Les Arcs, France (23 Jan 1988).

The quantum-gravity-inspired phenomenology for gravitational forces is described. New gravitational phenomena, qualitatively similar to those attributed to the so-called {open←quotes}fifth-force{close←quotes} are to be expected. The parameters of a model with these features have been constrained by the geophysical tests of the inverse-square law of Stacey, et al. This model is then able to explain the apparent discrepancies between the recent resuilts of Thieberger and of Adelberger and collaborators. A striking new prediction of the model is that antiprotons should experience a substantially larger gravitational acceleration than normal matter. Gravitational red-shift experiments are also proposed as tests for the new forces. 12 refs.

31816 **(LYCEN—8713) Non-bijective canonical transformations.** Kibler, M. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Apr 1987. 46p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753488/JAW.

In these lectures delivered at the Springer School of theoretical physics organized by the department of theoretical physics of the university of Constantine (Algeria) the generalization of two

transformations often employed in theoretical physics are studied: the Levi-Civita transformation and the Kustaanheimo-Stiefel transformation.

31817 **(SAND—88-0026C) Experiments on insulation of relativistic electron flows in oblique and tapered magnetic fields.** Mendel, C.W. Jr.; Quintenz, J.P.; Rosenthal, S.E.; Seidel, D.B.; Coats, R.; Savage, M.E. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA)). 1988. Contract AC04-76DP00789. 3p. (CONF-880687—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007199/JAW.

From 13. international symposium on discharges and electrical insulation in vacuum; Paris, France (27 Jun 1988).

Several experiments on magnetically insulated electron flows will be reported. These include experiments in combined axial and azimuthal magnetic fields like those seen in powerful ion diodes, and flows in which the degree of insulation is changed along the flow path. Conservation of transverse electron canonical momentum implies that the flows cannot be exactly in the ExB direction. Measurements of the field pitch (the ratio of the axial to the azimuthal magnetic field) show a tendency to flow in the ExB direction with very little current along the magnetic field. However, it was also found that the flow tended to find an equilibrium where electrons in ExB flow have only small transverse canonical momentum. Other data show a surprising degree of electron recapture at the cathode under some conditions. This has important implications for multi-terrawatt devices. 4 refs., 7 figs.

31818 **(UCID—21304) The propagation of irradiance moments of an aberrated, apodized FEL beam.** Teague, M.R. (Lawrence Livermore National Lab., CA (USA)). 29 Mar 1988. Contract W-7405-ENG-48. 13p.

It is pointed out that the size of the far field spot and its tranverse location may be found directly from the FEL output-plane irradiance and phase distribution. 5 refs., 3 figs.

31819 **Gravity as a gauge theory with Cartan connection.** Zardecki, A. (Theoretical Division, MS K723, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **29**: No. 7, 1661-1666(Jul 1988).

A gauge formulation of gravity, based on the notion of the connection of Cartan, is given. The Cartan connection involves two principal fiber bundles P and P' with groups G and G', respectively; G' is a subgroup of G and can be regarded as a symmetry group to which G is broken. When the differential form defining the connection in P gives absolute parallelism in P', one speaks about the Cartan connection. General geometric framework is specialized to the case in which G is the de Sitter group SO(4,1) and G' is the Lorentz group SO(3,1). The action of the Yang—Mills type is similar to, but not identical with, the action derived earlier by Townsend. The field equations in P are translated into a system of coupled equations for curvature and torsion in P'. Under contraction of SO(4,1) to the Poincare group ISO(3,1), and for vanishing torsion, the equations become Yang's equation and Einstein's equation in vacuum. The BRS invariance of the theory, supplemented by Faddeev—Popov and gauge fixing terms, is analyzed in some detail.

31820 **Algebraic time-dependent variational approach to dynamical calculations.** Shi, S.; Rabitz, H. (Department of Chemistry, Princeton University, Princeton, New Jersey 08544). *Journal of Chemical Physics;* **88**: No. 12, 7508-7521(15 Jun 1988).

A set of time-dependent basis states is obtained with a group of unitary transformations generated by a Lie algebra. Applying the time-dependent variational principle to the trial function subspace constructed from the linear combination of the time-dependent basis states gives rise to a set of "classical" equations of motion for the group parameters and the expansion coefficients from which the time evolution of the system state can be determined. The formulation is developed for a general Lie algebra as well as for the commonly encountered algebra containing homogeneous polynominal products of the coordinate Q and momentum P operators (or equivalently the boson creation a/sup dagger/ and annihilation a operators) of order 0, 1, and 2. Explicit expressions for the transition amplitudes are derived by virtue of the cannonical transformation properties of the unitary transformation. The applicability of the present formalism in a variety of problems is implied by two illustrative examples: (a) a parametric amplifier; (b) the collinear collision of an atom with a Morse oscillator.

31821 **Critical exponents and scaling relations for self-organized critical phenomena.** Tang, C.; Bak, P. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **60**: No. 23, 2347-2350(6 Jun 1988).

Critical indices β, γ, δ, ν, etc. are defined and calculated for self-organized critical phenomena. Scaling relations are derived and checked numerically. The order-parameter exponent β describes the spontaneous current and the relaxation to the critical point. The power spectrum has "1/f" behavior, with exponent phi = $\gamma/\nu z$, where z is the dynamical critical exponent.

31822 **Reply to "Comment on 'Bell's theorem and the foundations of quantum physics' " [Am. J. Phys. 56, 567 (1988)].** Stapp, H.P. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *American Journal of Physics;* **56**: No. 6, 568-569(Jun 1988). Contract AC03-76SF00098.

EPR locality is discussed from the point of view of determinism. (AIP)

31823 **Some methods for reducing propagation-induced phase errors in coherent imaging systems. I. Formalism.** Brown, W.D.; Ghiglia, D.C. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 6, 924-941(Jun 1988).

The random phase errors induced in an electromagnetic wave propagating through turbulence in the troposphere and/or the ionosphere can degrade the performance of a coherent imaging system such as a synthetic-aperture radar. Several methods for removing or reducing these phase errors are described. Some of these methods, such as cubic-spline approximations with map drift and a deterministic technique based on a Legendre-series expansion of the phase error, are not new but are included for comparison. At least three techniques are (to our knowledge) new; a binary multiplexing scheme, a method using the Wigner—Ville distribution, and an optimal estimator based on the covariance matrix of the Legendre-series expansion coefficients. The method based on the Wigner—Ville distribution promises to be the most effective in reducing the deleterious effects of the phase errors on image quality.

31824 **Some methods for reducing propagation-induced phase errors in coherent imaging systems. II. Numerical results.** Ghiglia, D.C.; Brown, W.D. (Sandia National Laoratories, Albuquerque, New Mexico 87185). *Journal of the Optical Society of America A: Optics and Image Science;* **5**: No. 6, 942-957(Jun 1988).

The phase-error mitigation methods are applied to computer-generated one-dimensional (the azimuthal dimension) synthetic-aperture radar images. These images represent a superposition of five point targets of different intensities and locations. Specific realizations of the turbulence-induced phase errors are constructed by the Karhunen—Loeve technique. A specific realization is added to the phase history of the point targets to obtain the phase history of the distorted image. Reasonable reconstructions from the phase histories of the distorted images, using cubic-spline fits based on either the map drift or the mean frequency difference, are obtained when low-frequency phase errors dominate the spectrum. Binary multiplexing and a deterministic method based on the Legendre-series expansion of the phase error also produce good results for the first eight terms of the expansion. The best reconstructions are obtained by using the Wigner—Ville distribution.

31825 **Generalized eigenfunction expansions for scattering in inhomogeneous three-dimensional media.** Rose, J.H.; Cheney, M. (Center for Nondestructive Evaluation, Iowa State University, Ames, Iowa 50011). *Journal of Mathematical Physics (New York);* **29**: No. 6, 1347-1355(Jun 1988).

An infinite number of ways are developed for representing a function in terms of the (generalized) eigenfunctions of a three-dimensional scattering problem and simple known auxiliary functions. The freedom represented by this variety of expansions arises from the causal nature of the wave equations considered. The new expansions are shown to generalize both the Fourier and Radon transforms. An application of the new expansions to the inverse scattering problem is given. It is shown (under some restrictions) that the scattering amplitude and potential are related via one of the generalized transforms.

31826 **General-relativistic implicit hydrodynamics in polar-sliced space-time.** Schinder, P.J.; Bludman, S.A.; Piran, T. (Physics Department, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] D: Particles and Fields;* **37**: No. 10, 2722-2731(15 May 1988).

We derive the equations of general-relativistic spherical hydrodynamics in a Lagrangian gauge subject to the condition of polar slicing of space-time, which gives both maximum coverage of material zones and stronger singularity avoidance than either synchronous (May and White) or maximally sliced coordinates. We present a fully relativistic, polar-sliced implicit computer code (gsmcapsr-smcapsIp-smcapso-smcapsS) for Lagrangian spherical hydrodynamics, and present the results of computations of two test problems: the approach to hydrostatic equilibrium of a near-equilibrium, initial configuration and the collapse of pressureless dust. We compare our results to the known solutions of these two tests. We also follow the collapse to a black hole of an equilibrium configuration after pressure reduction.

31827 **Propagator-based calculation of the propagation properties of dielectric waveguide structures.** Hawkins, R.J. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Applied Optics;* **27**: No. 10, 2033-2037(15 May 1988).

A simple expression for the propagator of a dielectric waveguide structure with an arbitrarily graded refractive-index profile is presented. This expression simplifies considerably the calculation of the propagation properties of dielectric waveguide structures described by z-independent paraxial optical Hamiltonians. The expression is based on the use of a short-distance approximation to simplify the formal path integral solution to the paraxial optical wave equation. The expression is incorporated into a simple and efficient numerical method for calculation of the propagation properties of dielectric waveguides with arbitrarily graded refractive-index profiles. The accuracy of this approach and its potential for use in optical design are illustrated by calculating the propagation constants and optical field distributions for a graded-index slab waveguide and a slab waveguide array.

31828 **Optical second-harmonic generation as a surface probe for noncentrosymmetric media.** Stehlin, T.; Feller, M.; Guyot-Sionnest, P.; Shen, Y. (Department of Physics, University of California, Materials and Chemical Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Optics Letters;* **13**: No. 5, 389-391(May 1988).

We show that optical second-harmonic generation can also be used as an effective surface probe with a submonolayer sensitivity for media without inversion symmetry. The adsorption of Sn on GaAs is used as an example. A detailed summary of all accessible elements of the surface nonlinear susceptibility tensor chi/sup (2)/ for the various crystal faces of GaAs is provided.

31829 **Where the sign of the metric makes a difference.** Carlip, S.; DeWitt-Morette, C. (Department of Physics and Center for Relativity, University of Texas at Austin, Austin, Texas 78712). *Physical Review Letters;* **60**: No. 16, 1599-1601(18 Apr 1988).

The groups Pin(n,m) and Pin(m,n) are not isomorphic, and the obstruction classes to their respective bundles are different. It follows that for nonorientable superstring theories the contributions to a Polyakov path integral from surfaces with positive metric are different from the contributions from those with negative metrics.

31830 **Fun and frustration with hydrogen in a 1+1 dimension.** Galic, H. (SLAC, Stanford University, Stanford, California 94305). *American Journal of Physics;* **56**: No. 4, 312-317(Apr 1988).

The Coulomb potential is derived in "one space--one time" dimension and introduced into Dirac and Klein--Gordon equations. The equations are solved and the somewhat surprising result: nonexistence of bound state solutions in the lower dimension: is discussed and identified as another fine example of the "Klein paradox."

31831 **Beam nonparaxiality, filament formation, and beam breakup in the self-focusing of optical beams.** Feit, M.D.;Fleck , J.A. Jr. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **5**: No. 3, 633-640(Mar 1988). Contract W-7405-ENG-48.

The paraxial wave equation, as is well known, predicts the catastrophic collapse of self-focusing beams. It is pointed out that this collapse is due to the loss of validity of the paraxial wave equation in the neighborhood of a self-focus. If nonparaxiality of the beam propagation is taken into account, on the other hand, a lower limit of the order of one optical wavelength is imposed on the diameter of a self-focus. A nonparaxial algorithm for the Helmholtz equation is applied to the self-focusing of Gaussian and ring-shaped beams. The self-focusing is noncatastrophic, and the results give insight into filament formation and beam breakup resulting from the self-focusing of optical beams.

31832 **Long-range forces and the Eoetvoes experiment.** Fischbach, E.; Sudarsky, D.; Szafer, A.; Talmadge, C.; Aronson, S.H. (Physics Department, Purdue University, West Lafayette, Indiana 47907 and Institute for Nuclear Theory, Department of Physics, University of Washington, Seattle, Washington 98195). *Annals of Physics (New York);* **182**: No. 1, 1-89(15 Feb 1988).

We present here the details of our reanalysis of the experiment of Eoetvoes, Pekar, and Fekete (EPF). After outlining our motivation for reexamining the EPF paper, we review the history of this experiment, which is described in some detail. A phenomenological framework is developed for describing the EPF and other similar experiments, and this then applied to analyzing the EPF data. We show that these data evidence a strong correlation between the measured fractional acceleration differences of various sample pairs of materials and the corresponding differences of baryon number-to-mass ratios. Such a correlation can result from a coupling of the test masses to an intermediate-range field whose source is baryon number, and it is shown that the properties of this field which emerge from geophysical data provide a fair description of the EPF results. We further demonstrate that no other known mechanism either conventional or otherwise, provides an adequate explanation of these data. Various experiments to check the EPF results are described, and in the Appendix we analyze the effects of local mass inhomogeneities which appear to represent the dominant sources in Eoetvoes-like experiments. copyright 1988 Academic Press, Inc.

70 FUSION ENERGY

7001 Plasma Research

REFER ALSO TO CITATION(S) 30451, 30869, 30994, 31432, 31437, 31481, 31614, 31793, 31910, 31914, 31937, 31938, 31946, 31952, 31954, 31955

31833 **(AD-A—189509/3/XAB) X-ray source model for z-pinch aluminum plasmas. Master's thesis.** Correll, R.R. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 94p. (AFIT/GEP/ENP—87D-3). NTIS, PC A05/MF A01.

This thesis develops a three-dimensional (x,y,z) x-ray radiation source model and a radiation-transfer model suitable for predicting x ray images from two-dimensional (r,z), cylindrically-symmetric, temperature and density profiles of a z-pinch aluminum plasma. The radiation, electron, and ion temperature and density

profiles are provided from an existing magnetohydrodynamic computer model. These temperatures and densities are used to characterize the emissive and transmissive properties of the plasma. The x-ray radiation transport through the plasma is solved using single-group, Monte Carlo integration methods. The emitted radiation is projected onto a hypothetical, far-field detector where an energy-flux image is measured. The results show that the model employing a Monte Carlo integration resulting from the emission from a z-pinch aluminum plasma.

31834 **(ANL/FPP/TM—219) Fast wave current drive: Experimental status and reactor prospects.** Ehst, D.A. (Argonne National Lab., IL (USA). Fusion Power Program). Mar 1988. Contract W-31109-ENG-38. 76p.

The fast wave is one of the two possible wave polarizations which propagate according to the basic theory of cold plasmas. It is distinguished from the other (slow wave) branch by having an electric field vector which is mainly orthogonal to the confining magnetic field of the plasma. The plasma and fast wave qualitatively assume different behavior depending on the frequency range of the launched wave. The high frequency fast wave (HFFW), with a frequency (ω2π {approximately} GHz) much higher than the ion cyclotron frequency (Ω/sub i/), suffers electron Landau damping and drives current by supplying parallel momentum to superthermal electrons in a fashion similar to lower hybrid (slow wave) current drive. In the simple theory the HFFW should be superior to the slow wave and can propagate to very high density and temperature without impediment. Experiments, however, have not conclusively shown that HFFW current drive can be achieved at densities above the slow wave current drive limit, possibly due to conversion of the launched fast waves into slow waves by density fluctuations. Alternatively, the low frequency fast wave (LFFW), with frequencies ({approx←lt} 100 MHz) only a few times the ion cyclotron frequency, is damped by electron Landau damping and, in a hot plasma ({approx←gt} 10 keV), by electron transit time magnetic pumping; current drive is achieved by pushing superthermal electrons, and efficiency is prediocted to be slightly better than for lower hybrid current drive. Most significantly, the slow wave does not propagate in high density plasma when ω {approximately} Ω/sub i/, so parasitic coupling to the slow wave can be avoided, and no density and temperture limitations are foreseen. Experiments with fast wve current drive invariably find current drive efficiency as good as obtained in lower hybrid experiments at comparable, low temperatures. 45 refs., 4 figs., 1 tab.

31835 **(CONF-871254—9) Infrared and far-infrared laser development for plasma diagnostics at Oak Ridge National Laboratory.** Casson, W.H.;Bennett, C.A.;Fletcher, L.K.;Hunter, H.T.;Hutchinson, D.P.;Lee, J.;Ma, C.DH.;Richards, R.K.;Vander Sluis, K.L. (Oak Ridge National Lab., TN (USA); Midwest Technical, Inc., Oak Ridge, TN (USA); North Carolina Univ., Asheville (USA); Tennessee Technological Univ., Cookeville (USA); Tennessee Univ., Knoxville (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007262/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

Three IR and FIR based diagnostics will be developed ann installed on the Advanced Toroidal Facility (ATF) at ORNL. An interferometer operating at 119 mu m will measure plasma density along 14 vertical chords across the plasma cross-section. A small-angle Thomson scattering experiment using a 10.6-mu m pulsed laser will determine the feasibility of measuring alpha particle distribution in a burning plasma. Plans are being developed for installing an FIR-based scattering experiment on ATF to measure density fluctuations. 4 refs., 4 figs.

31836 **(CONF-880249—1-Vugraphs) Requirements for neutral beam current drive in tokamaks.** Dory, R.A. (Oak Ridge National Lab., TN (USA)). [1988]. Contract AC05-84OR21400. 15p.

From US/Japan workshop on advanced current drive; Livermore, CA, USA (8 Feb 1988).

This paper contains viewgraphs on the use of neutral beam current drive in future tokamaks. Current profiles, slowing down distributions, beam destabilization of alfven waves and plasma parameters are some items covered in this paper. (DWL)

31837 **(CONF-880534—2) Analysis of plasma coupling with the prototype DIII-D ICRF antenna.** Ryan, P.M.; Hoffman, D.J.; Bigelow, T.S.; Baity, F.W.; Gardner, W.L.; Mayberry, M.J.; Rothe, K.E. (Oak Ridge National Lab., TN (USA)). 1988. 4p.

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

Coupling to plasma in the H-mode is essential to the success of future ignited machines such as CIT. To ascertain voltage and current requirements for high-power second harmonic heating (2 MW in a 35- by 50-cm port), coupling to the DIII-D tokamak with a prototype compact loop antenna has been measured. The results show good loading for L-mode and limiter plasmas, but coupling 2 MW to an H-mode plasma demands voltages and currents near the limit of present technology. We report the technological analysis and progress that allow coupling of these power densities. 5 refs., 4 figs.

31838 **(CTH-IEFT-PP—1986-16) Analytical models for predicting the ion velocity distributions in JET in the presence of ICRF heating.** Anderson, A.; Eriksson, L.G.; Lisak, M. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1986. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753007/JAW.

The present report summarizes the work performed within the contract JT4/9008, the aim of which is to derive analytical models for ion velocity distributions resulting from ICRF heating on JET. The work has been performed over a two-year-period ending in August 1986 and has involved a total effort of 2.4 man years. With 20 refs.

31839 **(CTH-IEFT-PP—1987-1) Explosive instabilities of reaction-diffusion equations.** Wilhelmsson, H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88753008/JAW.

Explicit solutions are obtained of evolution equations for explosively unstable situations including the effects of diffusion with linear or quadratic dependence on density of the diffusion coefficient. As a result of balance between the diffusion and nonlinear terms explosive growth in time can occur with a preservation in shape of certain spatial distributions. The solutions are generalized to cases of two interacting populations.

31840 **(CTH-IEFT-PP—1987-07) Simulations of tokamak disruptions.** Bondeson, A. (Chalmers Univ. of Tech., Goeteborg (Sweden). Inst. for Electromagnetic Field Theory and Plasma Physics). 1987. 19p. (CONF-8704170—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753009/JAW.

From International conference on plasma physics; Kiev, USSR (6 Apr 1987).

Three-dimensional resistive MHD simulations have been used to study major disruptions and how disruptive conditions arise at low-q or high-density operation of tokamaks. When the current density at the q=2 surface is low, violent MHD activity is triggered by the m=2/n=1 tearing mode becoming unstable. The disruption propagates as a front inward from the q=2 surface and leaves turbulent plasma with stochastic magnetic field behind itself. It is argued that the final stage of the major disruption is strongly dependent on toroidal effects.

31841 **(DOE/ER/53170—1) Maryland controlled fusion research program: Final technical progress report, period ending December 31, 1985.** (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). 1985. Contract AC05-84ER53170. 40p.

This final progress report describes the Univesity of Maryland research program on Magnetic Fusion Energy for the grant period ending December 31, 1985. This program consisted for four tasks: Plasma Theory; Electron Cyclotron Emission Diagnostics for Mirror Machines; Electron Cyclotron Emission Diagnostics on TFTR; and Atomic Physics.

31842 (DOE/ER/53221—2) Maryland Controlled Fusion Research Program: Progress report, October 1986-May 1987. Griem, H.R.; Liu, C.S. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). May 1987. Contract FG05-86ER53221. 16p.

In this paper we summarize the technical progress in five major areas: sawteeth in tokamaks; anomalous transport and profile invariance in tokamaks; anomalous current penetration and oscillating current drive in tokamaks; compact torus and RFP studies; and stability theory of tokamaks and other configurations. 17 refs.

31843 (EGG-M—17287) Developing diagnostic methods for plasma-particle interaction. Shaw, C.B. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 8p. (CONF-870679—4).

From 5. symposium on energy engineering sciences; Argonne, IL, USA (17 Jun 1987).

Three diagnostic methods for study of plasma-particle interactions are described. The first, the single-line method of emission spectroscopy for measurement of plasma temperature, is well established but required careful implementation of automatic methods for data reduction and analysis, and will need to be extended at a later date. The second, laser-induced fluorescence (LIF) for measurement of density of species vaporized from the particles, has been found to require substantial modification in experimental detail and data analysis from its origin in flame diagnostics. The third, Doppler-shifted Rayleigh scattering for direct measurement of plasma velocity, is a new undertaking suggested by a single published report of successful measurements on a very high current arc. 14 refs., 4 figs.

31844 (GA-A—19100) Fusion programs in Applied Plasma Physics and Development and Technology at GA Technologies Inc.: Annual report, fiscal year 1987. Overskei, D.O. (General Atomics Co., San Diego, CA (USA)). Jan 1988. Contract AC03-84ER53158. 89p.

Research carried out by GA for the Department of Energy Office of Fusion Energy provides key information and insight necessary for the development of fusion power systems. Highlights of the fusion theory effort described in this report include progress in numerical simulations of turbulent transport in tokamak plasmas, extension of novel theories of the H-mode, development and application of advanced codes for evaluating ECRF current drive efficiency, and new understanding and techniques for dealing with high beta tokamak equilibria. Experimental plasma research efforts are addresssing several important issues in fusion research. Neutron and alpha particle spectroscopy and triton confinement diagnostics are being developed to enable fusion researchers to understand alpha particle confinement and slowdown in burning plasmas. Development of Li beam diagnostic systems continued and has shown a capability for measuring both magnetic field pitch angle and relative current density profiles. Experiments on Ergodic Magnetic Divertor (EMD) phenomena on the Texas Experimental Tokamak (TEXT) continued to demonstrate low plasma edge temperatures and impurity reduction that make the concept attractive for reactor applications. GA led efforts continuing the Resonant Island Divertor (RID) experiments on TEXT using the EMD as a controlled magnetic perturbation. Research carried out in GA's Development and Technology programs included reactor systems design studies, and development of ferritic steels suitable for use as a structural material in fusion reactors. In the reactor systems design area, GA participated in the TITAN Reserved Field Pinch (RFP) Reactor Design Study. GA is responsible for project operation, safety design and analysis, and blanket shield neutronics calculations for this study.

31845 (GA-A—19216) A low divergence, high brightness lithium ion source for plasma diagnostics. Thomas, D.M.; West, W.P.; McCormick, K. (General Atomics Co., San Diego, CA (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Feb 1988. Contract AC03-84ER53158;AC03-84ER51044. 13p. (CONF-880364—20).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Plasma diagnostics employing lithium beams are in routine use on several present-day tokamak experiments. These measurements are constrained by the availability of a suitable lithium ion source. Necessary andor desireable parameters include narrow energy spread, high emission current density, simplicity, and long lifetime. The existing ion gun on the TEXT experiment uses the thermionic emitter β-eucryptite and meets the above requirements, except for being limited to a useful emission of about 4 mA. We will present design criteria and accelerator results for a new ion gun capable of 15 mA emission based on an increased emitter area. Important design considerations are the thermal and mechanical properties of the large ({approximately}20 cm^2) emitter area and the ion optics required to focus the emitted flux into a beam of {approximately}1 cm^2 cross section. The potential improvement in the performance of both the TEXT and ASDEX diagnostic systems will be discussed. 17 refs., 1 fig., 1 tab.

31846 (GA-A—19217) Poloidal field measurements using laser enhanced attenuation of an energetic lithium beam. West, W.P.; Thomas, D.M.; Thomas, M.P. (General Atomics Co., San Diego, CA (USA)). Feb 1988. Contract AC03-84ER53158. 13p. (CONF-880364—18).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The current density profile diagnostic system presently operating on the Texas Experimental Tokamak (TEXT) employs a cw dye laser system to induce fluorescence in a lithium beam injected into the discharge. Systematic effects due to the finite lifetime of the excited state and enhancement of the beam attenuation during laser excitation limit the application of this technique to plasma densities {approx<-lt} 1 {times} 10^{13} cm/sup {minus/3}. Laser enhancement of beam attenuation results from the large collisional ionization cross sections of the excited Li 2P state compared to the 2S ground state. This effect is exploited in a new diagnostic scheme which uses the polarization modulation of the present technique, but monitors the enhanced attenuation as opposed to the fluorescence. Detailed modeling indicates that a collinear beams configuration, with a short pulse laser and time of flight signal analysis, will provide a measurement of the complete poloidal field profile on TEXT at plasma densities up to 3 {times} 10^{13} cm/sup {minus/3} with 16 ms averaging times.

31847 (IPP—2/288) UDAS - data structure and data access routine. Kroiss, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753563/JAW.

The UDAS data format was designed to have the following properties: The structure of a data file should, if possible, 1. be simple and transparent, 2. contain all information required for complete interpretation of this dataset, 3. be flexible to allow fast and simple implementation of extensions and modifications, 4. avoid pointers, offsets, fixed type specifications, fixed sequences and fixed-length structures whenever possible, since such elements complicate the handling of a dataset and, furthermore, restrict the possibilities of the data acquisition system, 5. contain few different control block types and not prescribe fixed definitions or interpretations of the control blocks, and 6. be organized in records to allow fast access. Each record should only contain a single type of data in order to facilitate conversion to other computer systems. It was largely possible to satisfy all of the above requirements with the UDAS data format, mainly by means of the character representation (ASCII) of the control and description blocks. The data format, which is composed of only description and data blocks, thereby became very straightforward and flexible.

31848 (IPP—4/233) Study of the ICRF wave coupling on ASDEX-upgrade. Itoh, S.I.; Itoh, K.; Fukuyama, A.; Noterdaeme, J.M.; Steinmetz, K.; Wesner, F. (Hiroshima Univ. (Japan). Inst. of Fusion Theory; Kyoto Univ. (Japan). Plasma Physics Lab.; Okayama Univ. (Japan). School of Engineering). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Hiroshima Univ. (Japan). Inst. for Fusion Theory; Okayama Univ. (Japan). School of Engineering). Aug 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753565/JAW.

ICRF (ion cyclotron range of frequencies) wave on the ASDEX-upgrade tokamak is studied theoretically. By applying a

numerical code on the ICRF wave propagation to ASDEX-upgrade, the antenna coupling, wave accessibility and power deposition profile are calculated. The role of the scrape-off plasma on coupling is also discussed.

31849 **(IPP—6/269) Nonlinear resistive MHD-code in cylindrical geometry.** Jakoby, A. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753566/JAW.

A computer code has been developed which solves the full compressible resistive magnetohydrodynamic (MHD) equations in cylindrical geometry. The variables are expanded in Fourier series in the poloidal and axial directions while finite differences are used in the radial direction. The time advance is accomplished by using a semi-implicit predictor-corrector-scheme. Applications to the ideal m=1 ideal kink saturation in the nonlinear regime and the subsequent decay of the singular current layer due to resistivity are presented.

31850 **(JET-R—87-11) Model of the JET iron core.** Core, W.G.F.; Christiansen, J.P. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 23p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753095/JAW.

A model is developed for the calculation of the magnetic fields in JET. The model includes the important geometric features of the JET iron core, the material properties of the magnetic circuit, and is based upon a filamentary current loop representation of the plasma current. A solution for the magnetic vector potential is obtained. Application of the solution to a model with upper and lower connecting stubs leads to a simplification and the important geometric effects can be readily identified. Results of a parametric study with the model are given and a comparison with the results obtained from the Blum 2-D equilibrium code is made. The model is far less cumbersome, and significantly faster than other numerical codes that are currently available.

31851 **(JET-R—87-15) Fusion product measurements at JET.** Jarvis, O.N. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1987. 36p. (CONF-8707157—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753096/JAW.

From Plasma diagnostic summer school; London, UK (1 Jul 1987).

This paper provides a description of the diagnostic systems and techniques, based on the detection of nuclear fusion reaction products, which have been exploited at JET in order to obtain information on plasma conditions. The presentation has been illustrated with experimental findings which represent the first results from the various systems.

31852 **(Juel—2123) Properties of 'detached'-plasmas.** Samm, U.; Bay, H.; Bogen, P.; Hartwig, H.; Hintz, E.; Hoethker, K.; Lie, Y.T.; Pospieszczyk, A.; Ross, G.; Rusbueldt, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Mar 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753568/JAW.

The phenomenon 'detached'-plasma is described and analyzed, based on detailed experimental studies in the TEXTOR tokamak, in particular by applying comprehensive edge diagnostics. The major parameters responsible for the transition to a 'detached'-plasma are identified (heating power, electron density, impurity level) and can be related to a power loss via '100% radiation cooling' from low-Z impurities at the edge. The relevance for plasma-wall interaction, as evidenced e.g. by drastic changes in heat loads to the limiter, increase of particle flux to the wall, thereby enhancing the impurity release, is discussed. The great importance of considering the 'detached'-plasma properties in scaling studies and additional heating effects is demonstrated by the impact of this plasma state on particle and energy confinement times and by ICRF-heating induced transitions.

31853 **(Juel-Spez—418) Computational model for the confinement and performance of circular and D-shaped Tokamak plasmas.** Nicolai, A.; Boerner, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Oct 1987. 152p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88753577/JAW.

A combined one-dimensional and two-dimensional description of toroidal and axisymmetric plasmas is presented which is based essentially on an equilibrium solver resorting to the fast Buneman invertor and two one-dimensional transport codes describing the protium, deuterium, tritium, and plasma energy inventory and accounting for three impurity species; it is employed to compute the time evolution of Tokamak plasmas. The attempt was made to achieve a consistent modelling of the transport and equilibrium phenomena in a plasma which interacts with the peripheral devices for e.g. confinement, plasma heating and limitation of the plasma aperture. The equilibrium solver is connected to a coil submodule computing the poloidal field coil currents maintaining the designed plasma shape approximately. A surface current density standing for the magnetization of the iron core and the yokes is calculated by means of the module for the transformer iron. This module is linked to the equilibrium solver as well so that consistency between the coil currents, the plasma current distribution and the magnetization of the transformer iron is achieved.

31854 **(LA-UR—88-811) Detection of plasma equilibrium shifts with fiber optic sensing of image currents.** Forman, P.R.; Jahoda, F.C.; Miller, G. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 16p. (CONF-880364—15).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

The radial equilibrium position of Reverse Field Pinch experiments is determined by the j x B force on the plasma. The current density is that of the toroidal plasma current and the B field is the vertical magnetic field which is present in the plasma. This magnetic field is the result of several components. The main field, generated by the toroidal current windings, is corrected by adjustable trim windings to achieve a desired equilibrium position. There is an additional component to the field due to induced image currents in the close fitting conducting shell which encircles the plasma. These currents vary in time due to the finite L/R time of the conducting shell. It is the object of this paper to investigate the possibility of measuring these shell currents accurately using fiber optics so as to provide an analog signal to the equilibrium feedback circuit. 7 refs., 7 figs.

31855 **(LA-UR—88-895) Ion heating studies in the ZT-40M reversed field pinch.** Wurden, G.A.; Weber, P.G.; Schoenberg, K.F.; Schofield, A.E.; Phillips, J.A.; Munson, C.P.; Miller, G.; Ingraham, J.C.; Howell, R.B.; Downing, J.N.; Chrien, R.E.; Cayton, T.E.; Burkhardt, L.C.; Bastasz, R.J.; Walker, S.E.; Preszler, A.M.; Carolan, P.G.; Bunting, C.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880534—1).

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

A neutral particle analyzer (NPA) has been used on ZT-40M to measure the neutral deuterium spectra to an energy of 8keV. The NPA has confirmed the existence of a hot ion population during deeply reversed ramped discharges. Preliminary neutral flux modelling is consistent with {anti}n/sub e/ = 2.2 {times} $10^{19}m^{-3}$, T/sub e]{0}{approximately/ 300-400 eV, and a strongly peaked ion temperature profile, with T/sub i/(0) {approximately} 800 - 1100 eV, though the neutron yield incidates a higher energy tail may be present. The extra ion heating is attributed to fluctuations driven in the plasma under deep reversal andor current ramping conditions. With insertion of a paddle limiter into normal discharges, we confirm the HBTX result that T/sub i/(0)T/sub e](0) increases with isertion depth, although apparently due to a decrease in T{sub e/ rather than an increase in T/sub i/. 15 refs.

31856 **(PPPL—2491) The effect of electron thermal conduction on plasma pressure gradient during reconnection of magnetic field lines.** Chu, T.K. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Dec 1987. Contract AC02-76CH03073. 9p.

The interplay of electron cross-field thermal conduction and the reconnection of magnetic field lines around an m = 1 magnetic island prior to a sawtooth crash can generate a large pressure gradient in a boundary layer adjacent to the reconnecting surface, leading to an enhanced gradient of poloidal beta to satisfy the threshold condition for ideal MHD modes. This narrow boundary layer and the short onset time of a sawtooth crash can be supported by fine-grained turbulent processes in a tokamak plasma. 11 refs.

31857 **(PPPL—2499) Free boundary skin current MHD [magnetohydrodynamic] equilibria.** Reusch, M.F. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Feb 1988. Contract AC02-76CH03073. 38p.

Function theoretic methods in the complex plane are used to develop simple parametric hodograph formulae which generate sharp boundary equilibria of arbitrary shape. The related method of Gorenflo and Merkel is discussed. A numerical technique for the construction of solutions, based on one of the methods is presented. A study is made of the bifurcations of an equilibrium of general form. 28 refs., 9 figs.

31858 **(PPPL—2501) Measurements of energetic helium-3 minority distributions during ion cyclotron radio-frequency heating in the Princeton Large Torus.** Hammett, G.W.; Kaita, R.; Wilson, J.R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1988. Contract AC02-76CH03073. 15p.

Ion cyclotron radio-frequency heating experiments were performed with a ^{3}He minority ion species in a ^{4}He majority plasma in the Princeton Large Torus. The energetic ^{3}He ion "tail" was measured directly with a charge exchange neutral analyzer for the first time. Comparisons with bounce-averaged quasi-linear calculations suggest a modestly peaked radi-frequency power deposition profile. The double charge exchange process $^3He^{++}$ {plus} $^4He^0$ {plus} $^3He^0$ {plus} $^4He^{++}$ demonstrated in these measurements may be useful as part of an alpha particle diagnostic in a fusion reactor experiment. 18 refs., 4 figs.

31859 **(PPPL—2504) Spectra in the 60 {angstrom} to 345 {angstrom} wavelength region of elements injected into the PLT tokamak.** Wouters, A.; Schwob, J.L.; Suckewer, S.; Seely, J.F.; Feldman, U.; Dave, J.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics; Naval Research Lab., Washington, DC (USA). E.O. Hulburt Center for Space Research; Applied Research Corp., Landover, MD (USA)). Mar 1988. Contract AC02-76CH03073. 35p.

High resolution spectra of the elements Fe, Ni, Zn, Ge, Se, and Mo injected into the PLT tokamak were recorded by the 2-meter Schwob-Fraenkel soft X-ray multichannel spectrometer (SOXMOS). Spectra were recorded every 50 ms during the time before and after injection. The spectral lines of the injected element were very strong in the spectrum recorded immedately after injection, and the transition in the injected element were easily distinguished from the transitions in te intrinsic elements (C, O, Ti, Cr, Fe, and Ni). An accurate wavelength scale was established using well-known reference transitions in the intrinsic elements. The spectra recorded just prior to injection were substracted from the spectra recorded after injection, and the resulting spectrum was composed almost entirely of transitions from the injected element. A large number of $\Delta n + 0$ transitions between the ground and the first excited configurations in the Li I through K I isoelectronic sequences of the injected elements were identified in the wavelength region 60 {angstrom} to 345 {angstrom}. 33 refs., 5 figs., 1 tab.

31860 **(PPPL—2505) Bootstrap current in TFTR [Tokamak Fusion Test Reactor].** Zarnstorff, M.C.; Bell, M.G.; Bitter, M.; Goldston, R.J.; Grek, B.; Hawryluk, R.J.; Hill, K.; Johnson, D.; McCune, D.; Park, H.; Ramsey, A.; Taylor, G.; Wieland, R. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Mar 1988. Contract AC02-76CH03073. 17p.

Neutral-beam-heated plasmas in TFTR show evidence of substantial non-ohmically-driven toroidal current, even for balanced beam momentum input. The observations are inconsistent with calculations including only ohmic and beam-driven currents, and presently can only be matched by models including the neoclassical bootstrap current. 28 refs., 9 figs., 1 tab.

31861 **(PPPL—2506) Characteristics of radiated power for various TFTR [Tokamak Fusion Test Reactor] regimes.** Bush, C.E.; Schivell, J.; McNeill, D.H.; Medley, S.S.; Hendel, H.W.; Hulse, R.A.; Ramsey, A.T.; Stratton, B.C.; Dylla, H.F.; Grek, B.; Johnson, D.W.; Taylor, G.; Ulrickson, M.; Wieland, R.M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1988. Contract AC02-76CH03073. 18p.

Power loss studies were carried out to determine the impurity radiation and energy transport characteristics of various TFTR operation and confinement regimes including L-Mode, detached plasma, co-only neutral beam injection (energetic ion regime), and the enhanced confinement ("supershot") regime. Combined bolometric, spectroscopic, and infrared photometry measurements provide a picture of impurity behavior and power accounting in TFTR. The purpose of this paper is to make a survey of the various regimes with the aim of determining the radiated power signatures of each. 10 refs., 6 figs., 1 tab.

31862 **(PPPL—2507) Sawtooth stabilization by energetic trapped particles.** White, R.B.; Rutherford, P.H.; Colestock, P.; Bussac, M.N. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Ecole Polytechnique, 91 - Palaiseau (France)). Mar 1988. Contract AC02-76CH03073. 18p.

Recent experiments involving high power radio-frequency heating of a tokamak plasma show strong suppression of the sawtooth oscillation. A high energy trapped particle population is shown to have a strong stabilizing effect on the internal resistive kink mode. Numerical calculations are in reasonable agreement with experiment. 13 refs., 2 figs.

31863 **(UCID—21305) Lawrence Livermore National Laboratory DIII-D cooperation: 1987 annual report.** Allen, S.L.; Calderon, M.O.; Ellis, R.M.; Evans, J.C.; Ferguson, S.W.; Hill, D.N.; James, R.A.; Jenkins, S.L.; Karlsen, C.E.; Kevan, D. (Lawrence Livermore National Lab., CA (USA)). 24 Feb 1988. Contract W-7405-ENG-48. 24p. NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007491/JAW.

This report summarizes the Lawrence Livermore National Laboratory (LLNL) DIII-D cooperation during FY87. The LLNL participation in DIII-D concentrated on three principal areas: ECH and current-drive physics, divertor and edge physics, and tokamak operations. These topics are dicussed in this report. 27 refs., 11 figs.

31864 **(UCRL—53854) Microstability of the sloshing ions in TMX-U.** Berzins, L.V. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 164p.

We have measured the microstability of the sloshing ions in the Tandem Mirror Experiment-Upgrade (TMX-U). This is the first experimental measurement of the microstability of a sloshing-ion distribution. We found that the sloshing ions were unstable to the drift cyclotron loss-cone instability. This instability was driven at the outer turning-point of the sloshing ions. We compare the experimental observations with the theoretical predictions for the drift cyclotron loss-cone instability. It is on the basis of these comparisons that we identify this instability as the drift cyclotron loss-cone intability. This instability affected the lifetime of the sloshing ions. We compare the observed scaling of the sloshing-ion lifetime with the amplitude of the instability to the results of a quasilinear theory where ion trapping is important. We show that this instability can be stabilized by two diferent cold-ion populations in TMX-U. We observe warm plasma stabilization of the instability by the cold ion endlosses. The amoun of stream necessary to stabilize the instability is consistent with the theory for the drift cyclotron loss-cone instability. We also show that warm ions trapped at the midplane can stabilize this instability, even though the instability is driven at a lo-

cation removed from the midplane. This is the first experimental verification of the stabilizign effect of trapped ions for a sloshing-ion distribution. 125 refs., 33 figs.

31865 **(UCRL—98254) Properties of hydrogen/helium accretion plasmas.** Guessoum, N.; Dermer, C.D. (Lawrence Livermore National Lab., CA (USA); California Univ., San Diego, La Jolla (USA). Dept. of Physics). Feb 1988. Contract W-7405-ENG-48. 7p. (CONF-871245—4).

From Workshop on nuclear spectroscopy of astrophysical sources; Washington, DC, USA (14 Dec 1987).

We study the properties of impulsively-heated plasmas initially composed of hydrogen and helium. We follow the time-dependent behavior of the ion and electron temperatures, the pair density, and the densities of hydrogen, helium, and nuclei formed in fusion and breakup reactions. We also consider neutron production and escape, and calculate the 0.431 and 0.478 MeV line luminosities from α-α fusion reactions, and the 2.22 MeV line luminosity from neutron capture on protons. 13 refs., 3 figs., 1 tab.

31866 **(UWPR—88-2) Moment approach to neoclassical flows, currents and transport in auxiliary heated tokamaks.** Kim, Yil Bong. (Wisconsin Univ., Madison (USA). Dept. of Physics). Feb 1988. Contract FG02-86ER53218. 66p.

The moment approach is utilized to derive the full complement of neoclassical transport processes in auxiliary heated tokamaks. The effects of auxiliary heating [neutral beam injection (NBI) and ion cyclotron resonance heating (ICRH)] considered arise from the collisional interaction between the background plasma species and the fast-ion-tail species. From a known fast ion distribution function we evaluate the parallel (to the magnetic field) momentum and heat flow inputs to the background plasma. Then, through the momentum and heat flow balance equations, we can determine the induced parallel flows (and current) and radial transpot fluxes in "equilibrium" (on the time scale much longer than the collisional relaxation time, i.e., t >> 1ν/sub ii/). In addition to the fast-ion-induced current, the total neoclassical current includes the boostap current, which is driven by the pressure and temperature gradients, the Pfirsch-Schlueter current which is required for charge neutrality, and the neoclassical (including trapped particle effects) Spitzer current due to the parallel electric field. The radial transport fluxes also include off-diagonal compnents in the transport matrix which correspond to the Ware (neoclassical) pinch due to the inductive applied electric field an the fast-ion-induced radial fluxes, in addition to the usual pressure- and temperature-gradient-driven fluxes (particle diffusion and heat conduction). Once the tranport coefficient are completely determined, the radial fluxes and the heat fluxes can be substituted into the density and energy evolution equations to provide a complete description of "equilibrium" ($\delta\delta$t << ν/sub ii/) neoclassical transport processes in a plasma. 47 refs., 14 figs.

31867 **Ion-cyclotron-frequency stabilization of internal kink mode and sawtooth oscillations in tokamaks.** Litwin, C. (Department of Nuclear Engineering and Engineering Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **60**: No. 23, 2375-2378(6 Jun 1988).

It is proposed that the ponderomotive force due to applied ion-cyclotron resonance-frequency waves can stabilize the internal kink mode in tokamaks. The sufficient stability criterion is derived and the necessary power estimated. It is concluded that at the rf power level, present in the Joint European Torus experiment, the ponderomotive force effects are significant and may be responsible for the modification of the sawtooth activity observed in recent experiments.

31868 **Ion collection by probes in strong magnetic fields with plasma flow.** Hutchinson, I.H. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review [Section] A: General Physics;* **37**: No. 11, 4358-4366(1 Jun 1988).

Fluid-theory calculations are presented of ion collection by electric probes in strongly magnetized plasmas with parallel flow. In the first calculations the problem is treated in a one-dimensional approximation but the cross-field transport of momentum is included in such a way as to model different ratios of viscosity to diffusivity. The results show that the flow deduced from probe measurements is not particularly sensitive to the assumed viscosity, provided it is finite. However, results with zero viscosity are qualitatively different from those with nonzero viscous momentum transport. The second set of calculations is two dimensional but only for fixed (unity) ratio of viscosity to diffusivity. The results are in remarkably good agreement with the corresponding one-dimensional model.

31869 **Twenty-channel grating polychromator for millimeter wave plasma emission measurements.** Cavallo, A.; Cutler, R.C.; McCarthy, M.P. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **59**: No. 6, 889-894(Jun 1988).

A 20-channel grating instrument based on the Ebert—Fastie grating monochromator has been built to measure electron temperature profiles and electron temperature fluctuations in TFTR (tokamak fusion test reactor). Second-harmonic electron cyclotron emission for the plasma over the frequency range of 120—400 GHz is utilized; this corresponds to a central tokamak magnetic field of 2.9—5 T. System sensitivity is typically 10-eV rms for a 2.5-kHz bandpass with a 2.5-cm radial resolution and a 5-cm antenna spot size at the plasma center. The ratio of the largest to smallest plasma radius observed by the instrument can be as large as 1.65, which maximizes spatial coverage of the plasma. Emission is detected by 20 liquid-helium-cooled indium antimonide hot-electron bolometers mounted in a long hold cryostat. The 6.5-l helium reservoir must be filled every 19 days, while the liquid-nitrogen reservoir is filled automatically once a day. This instrument has about twice the number of channels and much better spatial resolution than other instruments of this type used for plasma diagnostics.

31870 **Franck—Condon energy spread in diagnostic neutral-particle-beam probes.** Foote, J.H. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Review of Scientific Instruments;* **59**: No. 6, 906-909(Jun 1988). Contract W-7405-ENG-48.

Plasma potentials can be measured in open-ended magnetic-fusion experiments with neutral beams injected at angles within the loss cone. Beam atoms that are ionized by the plasma follow magnetic-field lines and leave the machine with energy equal to their original beam energy plus the potential through which they have dropped. These diagnostic neutral beams often are composed of hydrogen or deuterium, and they can have components with energy less than the full beam energy because of the breakup of diatomic and triatomic molecules. The Franck—Condon energy released in this breakup can create a considerable energy spread in these lower-energy components. Here experimental results for this spread are summarized, obtained while using neutral beams for plasma-potential measurements in the Tandem Mirror Experiment-Upgrade (TMX-U). These energy-spread results agree with theoretical estimates. This inherent energy spread is emphasized because it can be important in interpreting plasma-potential data obtained with neutral-particle-beam probes and because its existence is not always anticipated.

31871 **Relativistic structure of stochastic wave—particle interaction.** Akimoto, K.; Karimabadi, H. (Earth and Space Sciences Division, Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 6, 1505-1514(Jun 1988).

Stochastic interactions of charged particles with electrostatic waves propagating at arbitrary angles to an external magnetic field are studied based on a relativistic canonical Hamiltonian formalism. The present theory, however, is valid also for electromagnetic waves after a slight modification. The stochasticity threshold is derived utilizing Chirikov's criterion. It is found that relativistic effects are important for electrons interacting with relatively high phase velocity waves even at nonrelativistic initial energies. In particular, the relativistic generalization of a previous theory [Phys. Rev. Lett. 34, 1613 (1975); Phys. Fluids 21, 2230 (1978)] moves the degeneracy of primary resonances in nearly perpendicular directions to the angles where the parallel phase speed approximately equals the speed of light. It was also demonstrated for the first time that initially low energy electrons can gain relativistic energies

($\gamma >> 1$) by means of the stochastic interaction with an electrostatic wave, where γ is the relativistic factor. Moreover, properties of second-order islands that form within primary islands have been studied. Finally, the nature of the stochastic particle energization by electrostatic waves is compared with that by electromagnetic waves, and the results are applied to the problem of electron acceleration during ionospheric modification experiments.

31872 Orbits in asymmetric toroidal magnetic fields. Cary, J.R.; Hedrick, C.L.; Tolliver, J.S. (Department of Astrophysical, Planetary, and Atmospheric Sciences and Department of Physics, University of Colorado, Boulder, Colorado 80309-0391). *Physics of Fluids;* **31**: No. 6, 1586-1600(Jun 1988).

Orbits in an asymmetric toroidal magnetic field are studied for the case in which the local variation of the field strength due to ripple is rapid compared with that due to toroidicity. In this case, to lowest order the poloidal variables are constant and particles move primarily in the toroidal direction. Invariants and averaged equations of motion for the locally passing and locally trapped particles are derived based on this approximation. The equations imply that transitions between the locally trapped and locally passing states occur. The probabilities for these transitions are calculated.

31873 Observation of radio-frequency field induced plasma loss in a simple mirror. Kuthi, A.; Olson, L.; Lam, K.L.; Zwi, H.; Wong, A.Y. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **31**: No. 6, 1787-1789(Jun 1988).

High-frequency parallel electric fields applied to plasmas confined in a simple magnetic mirror cause enhanced plasma loss. The plasma potential rises because of a population of electrons in the magnetic loss cone that are accelerated to parallel energies significantly higher than the bulk electron temperature. The radio-frequency induced plasma loss has a nonambipolar component, with ions lost predominantly in the radial direction.

31874 Numerical calculation of Mercier beta limits in spheromaks. Mayo, R.M.; Marklin, G.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 6, 1812-1815(Jun 1988).

By iteratively solving the Grad—Shafranov equation and the Mercier criterion, stable pressure profiles may be determined self-consistently with spheromak equilibria. No assumption is made about the shape of the pressure profile and an individual determination is made for that value of the pressure that drives the plasma marginally stable everywhere. These limits determine the pressure profile that provides the largest $<\beta>$/sub vol/ allowed by Mercier modes. Particular attention is given to the CTX spheromak [Phys. Rev. Lett. 51, 39 (1983)]. The results on spheromak Mercier stability limits leading to $<\beta>$/sub vol/ = 1.5% for sustained spheromaks are summarized. In addition, $<\beta>$/sub vol/ = 7.0% has been calculated for spheromaks with current holes.

31875 Laser-intensity scaling experiments in long-scale-length, laser-produced plasmas. Drake, R.P.; Young, P.E.; Williams, E.A.; Estabrook, K.; Kruer, W.L.; Lasinski, B.F.; Darrow, C.B.; Baldis, H.A.; Johnston, T.W. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* **31**: No. 6, 1795-1802(Jun 1988).

An experimental technique is demonstrated that allows variation of the average laser intensity by more than two orders of magnitude while producing much smaller changes in the other parameters that determine the laser—plasma interactions. By irradiating exploding-foil targets with 0.35 μm laser light in flat-topped pulses of variable duration, the high-power Nova laser [Rev. Sci. Instrum. 57, 2101 (1986)] produced plasmas with electron temperatures of order 1 keV and with scale lengths of the (radial and axial) electron-density gradients of order 1000 laser wavelengths. By using a constant target thickness and systematically decreasing the pulse length and spot size as laser intensity increased, the changes in the temperature and in the scale lengths were minimized. The time-resolved spectrum of the Raman-scattered light was used to measure both the electron temperature and the maximum density of the expanding plasmas. In this paper, these measurements are compared to both 1-D models and 2-D simulations. The expected trends of slower burnthrough and lower temperature with lower laser intensity were observed. However, the inferred temperatures are lower and the burnthrough of the target (at high laser intensities) is slower than the modeling predicts. Possible sources of these discrepancies are discussed.

31876 Variational nature of dispersion equations revisited. Schwarzmeier, J.L.; Lewis, H.R. (Los Alamos National Laboratory, MS-F642, Los Alamos, New Mexico 87545). *Journal of Mathematical Physics (New York);* **29**: No. 6, 1486-1497(Jun 1988).

Corrections and clarifications are made of some past treatments of the variational nature of the eigenfrequency calculation for dispersion equations and new results are presented. The main conclusions are the following: (1) Any relation between a normal mode and its dual must be consistent with the fact that the boundary conditions satisfied by the normal mode may differ from the adjoint boundary conditions satisfied by the dual. This will affect whether or not a given bilinear form will yield a variational result for the eigenfrequency. (2) If a dispersion matrix is constructed from the dispersion operator by using left and right basis functions that satisfy homogeneous boundary conditions on the dual eigenfunction and the eigenfunction, respectively, then generally a second-order accurate eigenfrequency is obtained by solving the matrix form of the dispersion equation. (3) When solving for the normal modes in terms of perturbation potentials, the adjoint boundary conditions are gauge dependent. For cases where the adjoint boundary conditions allow only the trivial solution for the dual eigenfunction, it may be possible to obtain variational results for the eigenfrequency by requiring that the trial functions for the normal mode and its dual satisfy variational boundary conditions.

31877 Collisional model of the plasma presheath. Scheuer, J.T.; Emmert, G.A. (Nuclear Engineering and Engineering Physics Department, University of Wisconsin: Madison, Madison, Wisconsin 53706-1687). *Physics of Fluids;* **31**: No. 6, 1748-1756(Jun 1988).

The problem of a collisional plasma flowing into a perfectly absorbing wall has been investigated using a kinetic approach. The plasma is assumed to have a nonzero ion temperature and a Boltzmann distribution of electrons. Ion collisions are included in the analysis through a Bhatnagar—Gross—Krook (BGK) collision term. An equation describing the electrostatic potential variation in the presheath region is derived. This equation is solved numerically for a range of collisionalities. In addition to the potential variation in the presheath, the ion distribution function, the wall potential, and the ion particle and energy fluxes into the sheath are also calculated. The calculation is repeated for three different cases. In the first case ion—neutral collisions are modeled by conserving only particles in the BGK operator. Ion—ion collisions are modeled by conserving particles and momentum in the second case, and by conserving particles, momentum, and energy in the third case. These results give insight into the role of collision conservation laws in describing the plasma flow.

31878 Bounce-averaged Monte Carlo collision operator and ripple transport in a tokamak. Albert, J.M.; Boozer, A.H. (Princeton Plasma Physics Laboratory, P. O. Box 451, Princeton, New Jersey 08543). *Physics of Fluids;* **31**: No. 6, 1809-1810(Jun 1988).

A bounce-averaged Monte Carlo pitch-angle scattering operator presented by Tolliver [Phys. Fluids 28, 1083 (1985)] is discussed and shown to follow directly from a bounce-averaged drift-kinetic equation of Connor and Cordey [Nucl. Fusion 14, 185 (1974)]. This operator is used in a discrete mapping analysis of radial transport of test particles in a slightly rippled tokamak, illustrating time step restrictions for its validity. This treatment of collisions is different than that of Yushmanov [Nucl. Fusion 23, 1599 (1983)] but gives the same results for ripple transport.

31879 Discrete mappings and resonant ripple transport in a tokamak. Albert, J.M.; Boozer, A.H. (Princeton Plasma Physics Laboratory, P. O. Box 451, Princeton, New Jersey 08543). *Physics of Fluids;* **31**: No. 6, 1811-1812(Jun 1988).

Discrete mappings are used to analyze bounce-averaged resonant ripple transport in a tokamak. The banana-shaped orbits of toroidally trapped test particles are subject to ripple-induced radial drift, collisionality, and toroidal precession, linearized about zero mod 2π for the case of resonance. The bounce-averaged mapping resembles a Taylor—Chirikov standard mapping, augmented by random collisions in two distinct ways. Each considered by itself gives a form of the standard map with noise that has been treated previously, in different contexts; the joint effect of both noise terms on the particle diffusion coefficient is discussed.

31880 **Application of nonlinear dynamical invariants in a single electromagnetic wave to the study of the Alfven-ion-cyclotron instability.** Otani, N.F. (Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **31**: No. 6, 1456-1464(Jun 1988).

Dynamical invariants are derived for particles moving in a single, circularly polarized electromagnetic wave of arbitrary time dependence propagating parallel to a uniform background magnetic field. The invariant associated with helical symmetry is shown to restrict the particle motion to a very narrow region of velocity space. Features of the slow time-scale motion of fixed points associated with the existence of a fourth adiabatic invariant are described for the case of a slowly varying wave. Characteristics of the particle motion thus derived are applied to the analysis of 1d—3v simulations of the saturation of the Alfven-ion-cyclotron (AIC) instability for a single wave. In particular, an explanation is offered for the appearance of a sharp edge in the velocity distribution function observed in the simulation.

31881 **Saturation of Kelvin—Helmholtz fluctuations in a sheared magnetic field.** Scott, B.D.; Terry, P.W.; Diamond, P.H. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 6, 1481-1491(Jun 1988).

Kelvin—Helmholtz unstable flows are numerically investigated in the context of a sheared E x B flow profile and a sheared magnetic field in the collisional, electrostatic limit. In the extreme form of this limit, density fluctuations are small and the system is described by the nonlinear E x B vorticity dynamics. In order to focus on the role of magnetic shear localization, the computations are confined to two dimensions. For weak magnetic shear the fluctuations become turbulent and saturate by nonlinear cascade to small (dissipative) scales. In a strong magnetic shear regime near the linear stability boundary, nonlinear spatial broadening allows direct access to resistive shear dissipation, leading to saturation at small amplitude with nearly all the fluctuation energy in the longest-wavelength mode. This is in accordance with previous investigation using a statistical closure analysis [Phys. Fluids 29, 231 (1986)]. The amount of broadening is proportional to the linear growth rate. The fluctuation amplitude scaling with magnetic shear is found to agree closely with the theory.

31882 **Relation of wave energy and momentum with the plasma dispersion relation in an inhomogeneous plasma.** Berk, H.L.; Pfirsch, D. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 6, 1532-1543(Jun 1988).

The expressions for wave energy and angular momentum commonly used in homogeneous and near-homogeneous media is generalized to inhomogeneous media governed by a nonlocal conductivity tensor. The expression for wave energy applies to linear excitations in an arbitrary three-dimensional equilibrium, while the expression for angular momentum applies to linear excitations of azimuthally symmetric equilibria. The wave energy E-script/sub wave/ is interpreted as the energy transferred from linear external sources to the plasma if there is no dissipation. With dissipation, such a simple interpretation is lacking as energy is also thermally absorbed. However, for azimuthally symmetric equilibria, the expression for the wave energy in a frame rotating with a frequency ω can be unambiguously separated from thermal energy. This expression is given by E-script/sub wave/ -ωL/sub wave/ l, where L/sub wave/ is the wave angular momentum defined in the text and l the azimuthal wavenumber and it is closely related to the real part of a dispersion relation for marginal stability. The imaginary part of the dispersion is closely related to the energy input into a system. Another useful quantity discussed is the impedance form, which can be used for three-dimensional equilibrium without an ignorable coordinate and the expression is closely related to the wave impedance used in antenna theory. Applications to stability theory are also discussed.

31883 **Study of resistive drift and resistive interchange modes in a cylindrical plasma with magnetic shear.** Sugama, H.; Wakatani, M.; Hasegawa, A. (Plasma Physics Laboratory, Kyoto University, Gokasho, Uji 611, Japan). *Physics of Fluids;* **31**: No. 6, 1601-1608(Jun 1988).

The resistive drift mode and resistive interchange mode in the presence of magnetic curvature and shear are studied theoretically as well as computationally, based on the electrostatic model equations of isothermal electrons and two-dimensional cold ions in a cylindrical geometry. There are two branches of unstable modes: one has characteristics similar to the resistive drift wave instability with a real frequency ω/sub r/ of the order of a diamagnetic frequency ω/sub */, and the other is a curvature driven mode (the resistive interchange instability) with chemical bondω/sub r/chemical bond = chemical bondω/sub i/chemical bond localized in the neighborhood of the resonant surface. The growth rates of both of these instabilities are proportional to ν^{1}2/sub e//sub i/ in the small ν/sub e//sub i/ limit, where ν/sub e//sub i/ is the electron—ion collision frequency. The resistive interchange instability is dominant even when the curvature drift frequency is a fraction of ω/sub */. Nonlinear evolution of these instabilities with multihelicity modes based on the model equations demonstrates a global spectrum condensation at the m = 0 mode, where m denotes the poloidal mode number. The saturated state generates a region of zonal flows in the azimuthal direction. Since particle transport across the constant phi surface vanishes, the zonal flow is expected to improve global confinement.

31884 **Resistive interchange instability criterion in anisotropic toroidal systems.** Johnson, J.L.; Hastie, R.J. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08543). *Physics of Fluids;* **31**: No. 6, 1609-1613(Jun 1988).

Ideal (Mercier) and resistive criteria for localized magnetohydrodynamic instabilities are derived for general toroidal systems with anisotropic pressure.

31885 **Macroscopic plasma oscillation bursts (fishbones) resulting from high-energy populations.** Coppi, B.; Migliuolo, S.; Porcelli, F. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 6, 1630-1648(Jun 1988).

Oscillation bursts (fishbones) of magnetically confined plasmas are associated with the excitation of an $m^{o} = 1$ mode when the ideal magnetohydrodynamic (MHD) threshold for the instability of this mode is reached. Near this threshold and in the absence of an effective "viscous" dissipative process, this mode remains marginally stable as a result of finite ion Larmor radius effects and has a real frequency of oscillation near the ion diamagnetic frequency. The release of the mode excitation energy related to the gradient of the plasma pressure, in the case of perpendicular neutral beam injection, is allowed by the resonant interaction of the mode with fast trapped ions that precess around the torus as a result of the curvature and the gradient of the confining magnetic field. This process plays the role of an effective viscosity. A consequence of the presented interpretation is that fishbone oscillations may also be excited in the case of parallel beam injection. In fact, for relatively low values of the beam transverse pressure, the basic mode frequency is related to the parameters of the target plasma and does not depend on the magnetic drift frequency of the beam particles that are injected nor on their velocity distribution.

31886 **Alpha loss-cone Alfven-wave instabilities in a sharp-boundary model of a tandem-mirror central cell.** Ho, S.K.; Nevins, W.M.; Smith, G.R.; Miley, G.H. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **31**: No. 6, 1656-1672(Jun 1988).

The Alfven waves of a cylindrical, sharp-boundary plasma, which models the plasma in a tandem-mirror central cell, have been analyzed for instabilities driven by the loss cone of the alpha-particle distribution function. Improved methods for treating the waves, the distribution function, and the instability have been developed and used. The many normal modes of the cylindrical plasma can be found reliably. The diffusion-front method for calculation of the distribution function allows accurate and rapid computation of instability growth rates and marginal-stability boundaries. Present tandem-mirror reactor designs have densities and temperatures that lead to instability. Consequences of the instability should be assessed by studying the quasilinear evolution of the alpha particles.

31887 **Spheromak tilt stabilization with an energetic particle component.** Mehanian, C.; Lovelace, R.V.E. (Department of Physics and Department of Applied Physics, Cornell University, Ithaca, New York 14853). *Physics of Fluids;* **31**: No. 6, 1681-1689(Jun 1988).

The tilt and shift stability of a spheromak plasma in the presence of a large orbit ion-ring component is determined by evaluating the magnetic interaction of the plasma with the ion ring and the external coils. Neither the ion-ring toroidal current nor the ring inverse aspect ratio is required to be small. The influence of conducting walls is considered to be negligible, as is appropriate for compression experiments. The plasma tilt and shift stability has been evaluated for a comprehensive set of numerically generated, self-consistent, hybrid spheromak/ion-ring equilibria. Stable equilibria are found over a considerable range of the parameters. The tilt stabilization of the plasma typically requires that more than about 25% of the total toroidal current be carried by the ion ring.

31888 **Nonlinear saturation of collisionless trapped particle instability in tandem mirrors.** Kim, S.Y.; Sen, A.K. (Plasma Research Laboratory, Columbia University, New York, New York 10027). *Physics of Fluids;* **31**: No. 6, 1690-1694(Jun 1988).

A collisionless trapped particle instability with magnetohydrodynamiclike growth rate is expected in tandem mirrors. To study its nonlinear state, a two-dimensional polarization drift nonlinearity in a cylindrical geometry is considered. Using three-wave nonresonant mode coupling of radially nonlocal eigenfunctions, two-mode coupling equations for the unstable fundamental and stable first-order radial harmonics are derived. The solution of mode-coupled equations yields the nonlinear saturation level. Mode coupling to the damped higher-order radial harmonics is the principal saturation mechanism of the unstable fundamental radial harmonic.

31889 **Anomalous electron diffusion across a magnetic field in a beam—plasma system.** Okuda, H.; Ono, M.; Armstrong, R.J. (Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08543). *Physics of Fluids;* **31**: No. 6, 1818-1821(Jun 1988).

The diffusion of electrons across a magnetic field in the presence of a beam—plasma instability has been studied by means of two-dimensional numerical simulations. It is found that the beam electrons can diffuse much faster across the magnetic field than the thermal electrons. This can be explained by the fact that the electrons in the beam are in resonance with the waves excited by the beam—plasma instability so that they experience a nearly d.c. electric field, causing large cE x B/B^2 excursions.

31890 **Evolution and breaking of ion-acoustic waves.** Rosenau, P. (Department of Mechanical Engineering, Technion, Haifa 32000, Israel and Center for Nonlinear Studies, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 6, 1317-1319(Jun 1988).

A new amplitude equation governing the velocity evolution of ion-acoustic waves in a collisionless plasma is derived: V/sub t// sub t/+(V^2)/sub x//sub t/ = [(1-V^2)V/sub x/] /sub x/+βV/sub x//sub x//sub t//sub t/. From this equation the existence of a critical amplitude threshold is immediately deduced, which leads to a double layer and above which solitary waves cannot exist. Above this threshold shock waves form and density undergoes explosive growth. Multidimensional waves and waves due to the magnetic drift are also considered.

31891 **Theory of fast-wave absorption, transmission, and reflection in the ion cyclotron range of frequencies.** Lashmore-Davies, C.N.; Fuchs, V.; Francis, G.; Ram, A.K.; Bers, A.; Gauthier, L. (Plasma Fusion Center, Massuchusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **31**: No. 6, 1614-1622(Jun 1988).

A second-order differential equation for the fast wave propagating in a hot, two-ion species plasma is obtained. This second-order approximation is obtained unambiguously and allows the wave amplitude to be identified with one of the electric field components. The approximation is based on replacing the coupling to the ion-Bernstein wave by a localized perturbation of the fast wave. For the case of perpendicular propagation, the second-order equation reduces to Budden's equation giving the well-known transmission coefficient for both two-ion hybrid and second-harmonic resonance. The equation includes the effect of simultaneous minority fundamental and majority second-harmonic cyclotron damping. The solutions of the second-order equation as a function of n/sub parallel/ give absorption transmission and reflection coefficients that agree well with the results based on models giving higher-order differential equations and solved by means of much more complex numerical codes.

31892 **Sawtooth stabilization by energetic trapped particles.** White, R.B.; Rutherford, P.H.; Colestock, P.; Bussac, M.N. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08543). *Physical Review Letters;* **60**: No. 20, 2038-2041(16 May 1988). Contract AC02-76CH03073.

Recent experiments involving high-power radio-frequency heating of a tokamak plasma show strong suppression of the sawtooth oscillation. A high-energy trapped-particle population is shown to have a strong stabilizing effect on the internal resistive kink mode. Numerical calculations are in reasonable agreement with experiment.

31893 **Experimental determination of line-intensity ratios for the n = 3 to n = 2 transitions of O V, F VI, and Ne VII at electron densities in a range of (4—9) x 10^{13} cm^{-3}.** Huang, L.K.; Lippmann, S.; Stratton, B.C.; Moos, H.W.; Finkenthal, M. (Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review [Section] A: General Physics;* **37**: No. 10, 3927-3934(15 May 1988).

This paper reports relative-line-intensity measurements of the n = 3 to n = 2 transitions for O V, F VI, and Ne VII in an electron density range of (4—9) x 10^{13} cm^{-3} in a tokamak plasma. Large discrepancies were found between the experimentally measured and theoretically computed values. The discrepancies are due to inaccuracies in the computations of the electron collision strengths from the $2s^2$ and 2s2p levels to the 2s3p levels, using either the R-matrix method or the distorted-wave approximation.

31894 **Slowing-down-tail enhancement of the neoclassical energy flux of α's.** Catto, P.J. (Plasma Research Institute, Science Applications Interantional Corporation, Boulder, Colorado 80302). *Physical Review Letters;* **60**: No. 19, 1954-1957(9 May 1988).

The retention of both drag and pitch-angle scattering of the energetic slowing-down-tail α's by the background ions can dramatically increase the radial energy flux of α's in an ignited tokamak and can prevent the α energy from being deposited into the background plasma via electron drag. The condition that the enhanced neoclassical fluxes have negligible impact on ignition can impose a more severe design constraint than drift loss.

31895 **Radio-frequency coupling to plasmas.** Colestock, P.L. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08540). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1975-1983(May 1988).

A survey of the physics associated with coupling rf power to plasmas is given with emphasis on methods of analysis relevant to applications in the fields of plasma production, processing, and fusion research. The significance of resonant versus nonresonant

coupling methods is discussed and specific applications are described where these phenomena dominate the coupling physics.

31896 **Characteristics of radiated power for various Tokamak Fusion Test Reactor regimes.** Bush, C.E.; Schivell, J.; McNeill, D.H.; Medley, S.S.; Hendel, H.W.; Hulse, R.A.; Ramsey, A.T.; Stratton, B.C.; Dylla, H.F.; Grek, B.; and others. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 2004-2007(May 1988).

Power loss studies were carried out to determine the impurity radiation and energy transport characteristics of various Tokamak Fusion Test Reactor (TFTR) operation and confinement regimes including low mode, detached plasma, co-only neutral beam injection (energetic ion regime), and the enhanced confinement ("supershot") regime. Combined bolometric, spectroscopic, and infrared photometry measurements provide a picture of impurity behavior and power accounting in TFTR. The purpose of this paper is to make a survey of the various regimes with the aim of determining the radiated power signatures of each.

31897 **Measurement of plasma potential using collecting and emitting probes.** Hershkowitz, N.; Cho, M.H. (Department of Nuclear Engineering and Engineering Physics, University of Wisconsin—Madison, Madison, Wisconsin 53706). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 2054-2059(May 1988).

Recently developed plasma potential diagnostic techniques which employ emissive probes are discussed. Using these techniques it is shown that it is possible to determine the plasma potential in plasma densities of $<10^4$ to 10^{13} cm^{-3}, neutral pressures of $<10^{-6}$ to 1 Torr, ion temperature ranging from 0.1 eV to 1 keV, and electron temperature from 0.1 to 150 eV. The techniques include measurements of the inflection point of the probe's I—V characteristic in the limit of zero electron emission, differential emissive probes in which a feedback circuit compares two probes with different emission, self-emissive probes in which plasma bombardment provides the probe heating, secondary emissive capacitive probes for which secondary electron emission coefficients are greater than 1.0, and current biased probes.

31898 **Back-averaging: An accelerated iterative method for simulating plasma diffusion.** Kress, M.E. (Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012). *Journal of Computational Physics;* **76**: No. 1, 201-230(May 1988).

A fast accurate multi-stage numerical method, back-averaging, is developed, analyzed, and optimized. The technique is used to solve an alternating dimensional numerical simulation of fusion plasma transport based on nonlinear resistive magnetohydrodynamics (MHD) equations. The geometry of the model is a complicated time-dependent two-dimensional configuration of flux contours analogous to a doublet. Numerical convergence rate comparisons of the optimized back-averaging method with various other iterative techniques for solving the numerical problem show that optimized back-averaging is the fastest method of all those considered. Moreover, to accomplish convergence in a practical length of time for extremely peaked profiles and complicated time varying configurations, back-averaging is essential. Further, with a minimum of additional computation, optimized back-averaging yields extreme accuracy. copyright 1988 Academic Press, Inc.

31899 **Wave propagation in k space and the linear ion-cyclotron echo.** Ye, H.; Kaufman, A.N. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Physical Review Letters;* **60**: No. 16, 1642-1644(18 Apr 1988). Contract AC03-76SF00098.

When a magnetosonic wave packet crosses the second-harmonic gyroresonance layer, it linearly excites an ion-pressure—anisotropy wave packet, which propagates only in k space. The latter wave in turn excites a second magnetosonic wave packet which appears as a time-delayed reflection from the resonance layer. We call this phenomenon a linear ion-cyclotron echo.

31900 **Experimental observation of ion hose instability.** O'Brien, K.J.;Kamin, G.W.;Lockner, T.R.;Wagner, J.S.;Shokair, I.R.;Kiekel, P.D.;Molina, I.;Armistead, D.J.;Hogeland, S.;Powell, E.T. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **60**: No. 13, 1278-1281(28 Mar 1988). Contract AC04-76DP00789.

A theoretically predicted instability of the ion-focus–regime guiding of intense relativistic electron beams, known as the ion hose instability, has been observed in an experiment. A 1.5-μs, 1.2-kA, 2.2-MeV electron beam has been successfully injected into and propagated down a 21-m preionized channel. Off-axis beam oscillations have been found to grow and then saturate at large amplitude. Observed growth times, real frequencies, and saturated amplitudes are in agreement with theoretical scaling predictions and with numerical simulation of the ion hose instability.

31901 **Electron heating by lower hybrid waves in the PLT tokamak.** Bell, R.E.;Bernabei, S.;Cavallo, A.;Chu, T.K.;Luce, T.;Motley, R.;Ono, M.;Stevens, J.;von Goeler, S. (Princeton Plasma Physics Laboratory, Princeton, New Jersey 08544). *Physical Review Letters;* **60**: No. 13, 1294-1297(28 Mar 1988). Contract AC02-76CH03073.

Lower hybrid waves with a narrow, high-velocity wave spectrum have been used to achieve high central electron temperatures in a tokamak plasma. Waves with a frequency of 2.45 GHz launched by a sixteen-waveguide grill at a power level less than 600 kW were used to increase the central electron temperature of the PLT plasma from 2.2 to 5 keV. Associated with this temperature increase was an apparent reduction in the central electron thermal diffusivity. The magnitude of the temperature increase depends strongly on the phase difference between waveguides and on the direction of the launched wave.

31902 **Overview of the Compact Ignition Tokamak.** Flanagan, C.A. (Oak Ridge National Lab., TN (USA)). pp 375-380 of Fusion technology 1986. 2 Vol. Proceedings of the 14. symposium, Avignon (FR), 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A national team has developed a baseline concept for a Compact Ignition Tokamak (CIT). The CIT mission is to achieve ignition and provide experimental capability to study the behavior of burning plasmas. The design uses large magnetic fields on axis (about 10 T) and large plasma currents (about 9-10 MA). The magnet structure derives high strength from the use of a copper-Inconel composite plate design in the nose region of the toroidal field (TF) coil and in the ohmic heating solenoid. Inertial cooling is used; liquid nitrogen temperatures are established at the beginning of each pulse. Capability is provided to operate either with a divertor or limiter based plasma. The design is very compact (1.32-m major radius, 0.43-m plasma radius), has 16 TF coils, and has 16 major horizontal access ports, about 30 cm by 80 cm, located between TF coils. The schedule is for a construction project to be authorized for the period FY 1988-93.

31903 **Studies on MHD oscillations on the TEXT tokamak.** Kim, S.B. Austin, TX; Univ. of Texas (1986). 88p. University Microfilms Order No. 87-06,043.

Thesis (Ph. D.).

Low-frequency MHD oscillations in the TEXT tokamak are studied using an array of 40 soft-x-ray detectors and three arrays of magnetic pick-up coils including TEXT standard diagnostics. First, double-sawtooth oscillations observed during low q/sub lim/ discharges are presented. A partial reconnection of magnetic fields under a hollow current profile appears to be responsible for the oscillations. A condition for a partial reconnection in terms of the ratio of the two q = 1 radii is obtained with a simple analytical model based on Kadomtsev's argument, and compared with the experimental results. Second, experimental evidence of the correlation between sawtooth period and energy confinement time is presented. Inconsistency between the scaling of sawtooth period by Jahns et al. and the reconnection time of magnetic field lines due to m = 1

mode by Kadomtsev is discussed. Finally, the geometric characteristics of magnetic-field fluctuations is presented. Correlations dimensions are estimated for Mirnov oscillations and magnetic turbulence. In a stationary state, the attractor for the Mirnov oscillations is basically circular.

31904 **Experimental equilibrium and stability studies of a linear high-beta I = 1 stellarator.** Hedin, E.R. Seattle, WA; Univ. of Washington (1986). 112p. University Microfilms Order No. 87-06,582.

Thesis (Ph. D.).

A high-beta linear l = 1 stellarator plasma is produced in a low-compression 3-m theta pinch (the High-Beta Q Machine) whose compression coils are modified to have a helical offset of 2 cm, and an axial helical period of 40 cm. Detailed internal magnetic-probe measurements, in conjunction with axial interferometry and excluded flux measurements, were used to measure the spatial structure and temporal behavior of field profiles, plasma pressures, current, and magnetic-axis location, which correspond to the predictions of ideal MHD theory. It is found that the higher-temperature, lower-density quasi equilibria are perturbed by a stable m = 1, k $\approx$ O oscillatory mode for which magnetic-probe measurements allow characterization of the internal-mode structure. This is compared with a plasma-fluid model which includes finite ion-Larmor-radius effects. Cooler, higher-density plasmas, having near-sharp-boundary profiles are also produced and are observed to be exponentially unstable (growth time of approximately 0.5 μsec) to an m = 1, k $\approx$ O mode. The stability behavior of these two types of plasmas is understood from the theory with finite-Larmor radius effects. The higher-temperature diffuse profiles provide stabilization. At the lower temperatures, the profiles are near-sharp-boundary with $\beta \approx 1$, and the mode becomes MHD unstable.

31905 **Plasma-filling rates in the Phaedrus-B thermal barriers.** Peranich, L.S. Madison, WI; Univ. of Wisconsin (1986). 117p. University Microfilms Order No. 87-01,868.

Thesis (Ph. D.).

Rates at which ions are trapped and produced in the thermal barriers of the Phaedrus-B tandem mirror were experimentally determined. The filling-in mechanisms considered are: (1) RF trapping of passing ions, (2) ionization of reflux from the limiters which surround the plasma, (3) ionization of diffuse gas, and (4) trapping of passing ions by collisional scattering. Trapping of the passing ions by RF waves which are resonant with the ion gyromotion in the barrier mirror cells is the dominant filling-in mechanisms, producing approximately 4.5 amperes of filling. Several amps of plasma ions strike the limiters in the thermal barriers, producing a large amount of desorbed gas. Some of this reflux is immediately ionized by the plasma, resulting in between 1.25 and 2.25 amps of filling. The remainder of the reflux diffuses around the vacuum chamber, with the pressure of this diffuse gas increasing during the lifetime of the plasma. Ionization of this diffuse gas produces as much as 2 amps of filling. Collisional scattering of passing ions produces very little filling because of the magnetic field geometry of the Phaedrus-B thermal barriers. Analysis of the experimental results indicates that the ions trapped in the barrier mirror cells are removed radially from the plasma by some passive pumping mechanism. The filling-in mechanisms and passive pumping are simulated by a Monte Carlo code.

31906 **Spectroscopic analysis of low-Z impurities in the Tandem Mirror Experiment-upgrade.** Yu, T.L. Baltimore, MD; Johns Hopkins Univ. (1986). 145p. University Microfilms Order No. 87-07,237.

Thesis (Ph. D.).

Two absolutely calibrated EUV instruments were used to study the impurity characteristics in the Tandem Mirror Experiment-Upgrade (TMS-U). One instrument is a normal-incidence spectrograph that measures the time histories of several impurity emission lines (300-1800 A) in a single shot; radial scans can be obtained on a shot-by-shot basis. The other instrument is a monochromator that measures time-resolved radial profiles of a given impurity emission line in a single shot. The common intrinsic impurities measured in TMX-U are C, N, O, and Ti. It is shown that large fractions of the oxygen and nitrogen in the plasma are associated with the neutral beams while the main source of carbon is the plasma wall. In general, the concentration of each of the impurities is low (<1%), and the power radiated by them is less that 10 kW, which is a small portion of the total input power to the plasma. Concentrations of the impurities can be reduced substantially by glow-discharge cleaning and titanium gettering. No significant accumulation of impurity ions in the thermal barrier region was observed. Impurity-study experiments were also conducted in the TEXT tokamak using the same normal-incidence spectrograph and a time-resolving grazing-incidence spectrograph. Results show that the resonance structure is important in the calculation of excitation rates for low-Z elements at low energy levels.

31907 **Reduced-fluid descriptions of toroidally confined plasma with finite-ion-temperature effects.** Hsu, C.T. Austin, TX; Univ. of Texas (1986). 204p. University Microfilms Order No. 87-06,024.

Thesis (Ph. D.).

Fluid descriptions of toroidally confined plasma with FLR effects are studied, based on a generalized, energy-conserving, self-consistent, nonlinear reduced-fluid model (HHM). The model, derived via a fluid approach starting from moment equations, differs from Braginskii's fluid system in retaining O(rho/sub i/^{2}) terms (where rho/sub i/ is the ion gyroradius) and most of the non-ideal effects. Hence, many of the well-known reduced-fluid models can be reproduced from HHM by simply specifying scales of some parameters such as rho/sub i/ and β. On the other hand, a Pade approximation of the full FLR system, obtained from the simplified version of HHM, is also presented. This simplified model is not only energy-conserving and much easier to access, but also can be shown to retain FLR effects quite accurately. It is therefore remarked that this version should deserve further analytical and numerical studies. The possible applications of HHM are discussed in a general way so that further detailed studies can readily follow. In particular, linear toroidal drift-tearing modes with finite ion-temperature effects are studied. In addition, the non-canonical Hamiltonian theory and it's application to the reduced system are discussed. This fast developing theory has been useful for studying the equilibria and nonlinear instability of the fluid system.

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REFER ALSO TO CITATION(S) 30324, 30861, 31615, 31615, 31724, 31896

31908 **(AEEW-R—2132) Atomic displacement cross-sections in graphite for neutrons of 14 MeV.** Adamson, J. (UKAEA Atomic Energy Establishment, Winfrith). Sep 1986. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752736/JAW.

The paper presents the atomic displacement cross sections in graphite in the neighbourhood of 14 MeV, in connection with irradiation damage in graphite in the Next European Torus (NET). In one design for NET, the inner wall of the torus is lined with graphite, and it is assumed that this liner will suffer bombardment predominantly by the first flight of 14 MeV neutrons from the fusion reaction. The displacement cross sections are derived using cross section data for fast reactors. The formulation of recoil cross sections is discussed with respect to elastic scattering, inelastic scattering and the n δ reaction. The formulation of displacement cross sections is given, along with the values for recoil and displacement data. (U.K.).

31909 **(CEA-N—2546) Fusion technology program: progress report 1982-1986. Ceramic insulators.** Valin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). 1987. 12p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753060/JAW.

This task action, initially entitled "simulation of 14 MeV neutron radiation damage for NETINTOR" was re-defined at a meeting convened by the NET Team at Garching in 1984. The title was changed for "Ceramic insulators for NET" and the importance of the effect of ionizing radiation in some applications was raised. Applications were definitely listed: insulators for neutral beam injector, first wall insulator , torus break, diagnostics windows and radiofrequency windows. Moreover priority was chosen to give to

the radiofrequency windows study. Materials to be investigated were recalled: Al_2O_3, Al_2O_4Mg, Si_3N_4, ALON, SiO_2, MgO, BeO, $Y_3Al_5O_{12}$. CEA chose to investigate Al_2O_3 (MgO, nAl_2O_3). The work at CEA is adressing the following points: materials, thermal, mechanical, dielectrical characterization, neutron irradiation for CEA and KfK, dielectrical measurements under ionizing radiation.

31910 **(CONF-860652—35) Physics guidelines for the Compact Ignition Tokamak.** Sheffield, J.;Dory, R.A.;Houlberg, W.A.;Uckan, N.A.;Bell, M.;Colestock, P.;Hosea, J.;Kaye, S.;Petravic, M.;Post, D. (Oak Ridge National Lab., TN (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; General Atomics Co., San Diego, CA (USA); Massachusetts Inst. of Tech., Cambridge (USA); California Inst. of Tech., Pasadena (USA); Texas Univ., Austin (USA)). 1986. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007276/JAW.

From 7. topical meeting on the technology of fusion energy; Reno, NV, USA (15 Jun 1986).

The goal of the Compact Ignition Tokamak (CIT)d program is to provide a cost-effective route to the production of a burning deuterium-tritium plasma, so that alpha-particle effects may be studied. A key issue to be studied in the CIT is whether alpha power behaves like other power sources in affecting tokamak plasma confinement. The program is managed by the Princeton Physics Laboratory and includes broad community involvement. Guidelines for the preliminary design effort have been provided by the Ignition Technical Oversight Committee in discussion with the tokamak community. The reference design is a tokamak with a high filed (10 T), high current (10 MA), poloidal divertor, and liquid-nitrogen-cooled coils. It is a small, high-power-density device of the type proposed by Bruno Coppi (MIT). It has a major radius of 1.23 m, a minor radius of 0.43 m, and plasma elipticity of 1.8. This paper reviews the aims of the program and the basis for the physics guidelines. The role of the CIT in the longer-term tokamak program is briefly discussed. 23 refs., 9 figs., 1 tab.

31911 **(CONF-860914—36) A rapid, semiempirical method of calculating the stability margins of superconductors cooled with subcooled He-II: [Final report].** Dresner, L. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 4p. NTIS, PC A02;3. Order Number DE88007264/JAW.

From Applied superconductivity conference (ASC '86); Baltimore, MD, USA (28 Sep 1986).

A rapid, semiempirical method is presented for calculating the stability margins of superconductors cooled with subcooled He-II. Based on a model of Seyfert, the method takes into account both time-dependent Gorter-Mellink heat transport and the effects of interfacial Kapitza resistance. The method has been compared favorably with heat transfer data of Seyfert, stability data of Meuris, and stability data of Pfotenhauer and van Sciver. 4 refs., 7 figs., 1 tab.

31912 **(CONF-860917—12-FP) Overview of the compact ignition tokamak.** Flanagan, C.A. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 7p.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A national team has developed a baseline concept for a Compact Ignition Tokamak (CIT). The CIT mission is to achieve ignition and provide experimental capability to study the behavior of burning plasma. The design uses large magnetic fields on axis (about 10 T) and large plasma currents (about 9-10 MA). The magnet structure derives high strength from the use of a copper-Inconel composite plate design in the nose of region of the toroidal field (TF) coil and in the ohmic heating solenoid. Inertial cooling is used;liquid nitrogen temperatures are established at the beginning of each pulse. Capability is provided to operate either with a divertor or limiter based plasma. The design is very compact (1.32-m major radius, 0.43-m plasma radius), has 16 TF coils, and has 16 major horizontal access ports, about 30 cm by 80 cm, located between TF coils. The schedule is for a construction project to be authorized for the period FY 1988-93.

31913 **(CONF-870552—29) SAMS: The synchronization and monitoring system for ATF [Advanced Toroidal Facility] data acquisition.** Greenwood, D.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 2p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007268/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

SAMS performs much of the synchronization of the distributed data acquisition system for the Advanced Toroidal Facility (ATF). SAMS is responsible for propagating shot information and managing te data system directories and logical names. This paper describes how SAMS communicates with other processes, both within the VAX cluster that supports most of the ATF data acquisition and on VAXes that are connected to the cluster via DECnet. 3 refs.

31914 **(CONF-870552—30) Upgrade of MHD data acquisition system from ISX-B [Impurity Study Experiment] to ATF [Advanced Toroidal Facility].** Bell, J.D.;Pare, V.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007266/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The data acquisition system assembled to study magnetohydrodynamic (MHD) activity on the Impurity Study Experiment (ISX-B) tokamak at Oak Ridge National Laboratory (ORNL) is being revised for use on the Advanced Toroidal Facility (ATF). The new hardware and software architectures are based on ISX-B experience and will feature different modes of operation for storing various subsets of available data, a user interface that requires less routine activity than the earlier system, and continued support of calibration and testing measurement used on ISX-B. The new hardware organization and software components are described in detail. 2 refs., 5 figs., 1 tab.

31915 **(CONF-870552—31) The ATF [Advanced Toroidal Facility] Data Management System: [Final report].** Kannan, K.L.;Baylor, L.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007265/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Advanced Toroidal Facility (ATF) Data Management System (DMG) is a VAX-based software system that provides unified data access for ATF data acquisition and analysis. The system was designed with user accessibility, software maintainability, and extensibility as primary goals. This paper describes the layered architecture of the system design, the system implementation, use, and the data file structure. 3 refs., 1 fig.

31916 **(CONF-870552—36) The data acquisition and control systems for ATF [Advanced Toroidal Facility]: An overview.** Stewart, K.A.;Baylor, L.R.;Greenwood, D.E.;Kannan, K.L.;Overbey, D.R.;Wing, W.R.;Sumner, J.N.;DeVan, W.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02;3. Order Number DE88007277/JAW.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A data acquisition and control system is being developed to support the Advanced Toroidal facility (ATF) at Oak Ridge National Laboratory (ORNL). This system has two separate elements: a VAX-based data acquisition and management system and a status and control system that uses programmable logic controllers (PLCs). Although these systems can operate independently, they are intended to cooperate fully and complement one another. This paper presents an overview of the hardware components, software architecture, and operations of these systems. 3 refs., 2 figs.

31917 (CONF-880166—1-Vugraphs) ITER test program reliability and availability: Status and plans. Thomson, S.L. (Bechtel National, Inc., Oak Ridge, TN (USA)). [1988]. Contract AC05-84OR21400. 11p.

From ITER review meeting; Princeton, NJ, USA (19 Jan 1988).

This paper discusses the reliability and availability requirements for the ITER Test program. Graphs on the run time reliability are given. (LSP)

31918 (CONF-880417—3) Experimental and analytical investigations of mass transport processes of 12Cr-1MoVW steel in thermally-convected lithium systems. Bell, G.E.; Abdou, M.A.; Tortorelli, P.F. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering; Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 18p.

From International symposium on fusion nuclear technology; Tokyo, Japan (10 Apr 1988).

Experimental data on corrosion and mass transport in lithium12Cr-1MoVW steel were obtained from two thermal convection loops; one operated from 360 to 505°C for 3040 hours and the other from 525 to 655°C for 2510 hours. The experimental effort was supported by analytical investigations of mechanisms of corrosion and mass transport. It was found that mass transfer is not a simple function of temperature and alloy component solubility, but that temperature gradient also plays an important role. Above 580°C mass transfer appears dominated by temperature gradient. Between 450 and 580°C, mass transfer appears related to surface reactions involving nitrogen in lithium with chromium, and carbides on the steel surface. The corrosion rates from this work are significantly lower than those adopted in recent blanket design studies. 16 refs., 5 figs.

31919 (CONF-880534—3) The JET [Joint European Torus] multipellet launcher and fueling of JET plasmas by multipellet injection. Milora, S.L.; Schmidt, G.L.; Jernigan, T.C.; Baylor, L.R.; Combs, S.K.; Houlberg, W.A.; Schissel, D.; Colestock, P.; Hammett, G.; Zarnstorff, M.; Kupschus, P.; Cheetham, A.; Denne, B.; Gadeberg, M.; Gowers, C.; Gondhalekar, A.; Tubbing, B. (Oak Ridge National Lab., TN (USA); JET Joint Undertaking, Abingdon (UK)). 1988. Contract AC05-84OR21400. 4p. (CONF-880534—).

From 15. European conference on controlled fusion and plasma heating; Dubrovnik, Yugoslavia (16 May 1988).

A new multipellet long-pulse plasma fueling system is in operation on JET. In the initial experimental phase, a variety of plasma density profile shapes have been produced with peak to average values ranging up to 2.5 and peak plasma density up to 1.2 {times} 10^{20}m/sup {minus/3}. 7 refs., 4 figs.

31920 (CONF-880613—1) The postirradiation tensile properties and microstructure of several vanadium alloys. Braski, D.N. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 39p.

From 14. international symposium on effects of radiation on materials; Andover, MA, USA (27 Jun 1988).

Tensile specimens of V-15Cr-5Ti, Vanstar-7, V-3Ti-1si, and V-20Ti were irradiated at 420{degrees}C in FFTF-MOTA to a damage level of 82 dpa. Helium was preimplanted to levels up to 480 appm in selected specimens using a modified tritium trick. Irradiation hardening was the dominant effect influencing the postirradiation tensile properties, and it markedly increased the yield strength and reduced the total elogation. The V-15Cr-5Ti alloy was very sensitive to helium embrittlement, but Vanstar-7 and V-3Ti-1Si were only slightly affected. Without helium, negligible swelling (<1%) were measured in V-3Ti-1Si and V-20Ti. Preimplanted helium increased swelling in V-3Ti-1Si by increasing cavity nucleation. 11 refs., 11 figs., 3 tabs.

31921 (CONF-8706125—26) Operating experience of the IFSMTF [International Fusion Superconducting Magnet Test Facility] vapor-cooled lead system. Lue, J.W.;Fehling, D.T.;Fietz, W.A.;Lubell, M.S.;Luton, J.N.;Schwenterly, S.W.;Shen, S.S.;Stamps, R.E.;Thompson, D.H.;Wilson, C.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01;1; GPO Dep. Order Number DE88007275/JAW.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The International Fusion Superconducting Magnet Test Facility (IFSMTF) uses six pairs of vapor-cooled leads (VCLs) to introduce electric power to six test coils. Each VCL is housed in a dewar outside the 11-m vacuum vessel and is connected to the coal via a superconducting bus duct;the various VCLs are rated at 12 to 20 kA. Heat loss through the leads constitutes the single largest source of heat load to the cryogenic system. Concerns about voltage breakdown if a coil quenches have led to precautionary measures such as installation of a N_2-purged box near the top of the lead and shingles to collect water that condenses on the power buses. A few joints between power buses and VCLs were found to be inadequate during preliminary single-coil tests. This series of tests also pointed to the need for automatic control of helium flow through the leads. This was achieved by using the resistance measurements of the leads to control flow valves automatically. By the time full-array tests were started, a working scheme had developed that required little attention to the leads and that had little impact on the refrigerator between zero and full current to the coils. The operating loss of the VCLs at full current is averaging at about 7.4 gs of warm flow and 360 W of cold-gas return load. These results are compared with predictions that were based on earlier tests. 4 refs., 6 figs.

31922 (CONF-8706125—27) Quench detection by fluid dynamic means in cable-in-conduit superconductors. Dresner, L. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02;3; GPO Dep. Order Number DE88007269/JAW.

From Cryogenic engineering conference; St. Charles, IL, USA (14 Jun 1987).

The tight confinement of the helium in cable-in-conduit superconductors creates protection problems because of the substantial pressure rise that can occur during a quench. But the same pressure rise offers the useful possibility of a non-electrical means of detecting incipient quenches by monitoring the outflow from the various hydraulic paths of the magnet. If the method is to work, the signal must be large enough to be detected unambiguously at an early enough time, and the signal must not depend too strongly on the length, Joule power density, or rate of growth of the initial normal zone (because these things are not entirely within our control). This paper explores by calculation the degree to which these conditions can be met. The Westinghouse coil for the Large Coil Task (LCT) is used as the basis for illustrative examples. 3 refs., 2 figs.

31923 (DOE/DP/20137—T2) Review of the Department of Energy's Inertial Confinement Fusion Program. (National Research Council, Washington, DC (USA). Commission on Physical Sciences, Mathematics, and Resources). Mar 1986. Contract AC01-85DP20137. 72p.

The ultimate goal of the ICF Program is to demonstrate that a small capsule filled with a mixture of deuterium and tritium fuel can be compressed and heated sufficiently in the laboratory with laser or particle beam energy to undergo an efficient thermonuclear reaction while the capsule is confined by its own inertia. This miniature explosion must yield substantially more energy than was delivered by the driver. Best current estimates are the 1-10 MJ of driver energy will be needed and 100-1000 MJ of thermonuclear energy may be produced by the burning pellet. The Committee has taken as its charge to study ICF efforts with laser or particle beam drivers within the weapons R and D program. Since heavy ion fusion is supported primarily in other DOE programs, it was only briefly reviewed and not given much subsequent thought by the Committee. Also, alternative ICF schemes have been considered. The Committee did not attempt to compare ICF with other weapons or weapons research programs or with other energy programs.

31924 **(DOE/DP/40200—40) Modeling nonlocal heat flow in laser-produced plasmas.** Holstein, P.A.; Delettrez, J.; Skupsky, S.; Matte, J.P. (Rochester Univ., NY (USA). Lab. for Laser Energetics; Quebec Univ., Varennes (Canada). Energy Research Centre). Jun 1986. Contract FC08-85DP40200. 21p.

Nonlocal heat transport is investigated under conditions relevant to laser-driven fusion. Results from the nonlocal transport of Luciani and Mora are compared with results from Fokker-Planck codes and from local flux-limited diffusion simulations. No significant nonlocal effects are found in hydrodynamic simulations for irradiation with either 1.06 μm or 0.35 μm laser light. Over a large range of conditions, the transport is well modeled with a harmonic averaged flux-limiter between 0.1 and 0.2. 13 refs., 4 figs., 3 tabs.

31925 **(DOE/ER/53245—1) Design studies of low aspect-ratio torsatrons: Annual progress report, 1 June 1987-1 March 1988.** Hanson, J.D. (Auburn Univ., AL (USA). Dept. of Physics). 1 Mar 1988. Contract FG05-87ER53245. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88007562/JAW.

Low aspect ratio is one of many design criteria for torsatrons. A new magnetic field design technique based on the Hamiltonian structure of magnetic field line flow is used to investigate feasible torsatron configurations. Significant improvements have been made in the computer code IFS. The problem of too large a magnetic axis wobble has been solved with the addition of an {ell} = 1 m = 6 helical coil. 4 refs., 2 figs., 1 tab.

31926 **(EGG-EP—7853) Ecological environment of the proposed site for the Compact Ignition Tokamak at Princeton Plasma Physics Laboratory.** (Envirosphere Co., Lyndhurst, NJ (USA)). Dec 1987. Contract AC07-76ID01570. 90p.

This report gives a description of the exological environment of D-site and the surrounding area at Princeton Plasma Physics Laboratory (PPPL) near Princeton, New Jersey. D-site at PPL is the proposed location for construction of a new fusion test facility, the Compact Ignition Tokamak (CIT). This report was prepared as supplemental information for an Environmental Assessment for the proposed CIT at PPL. The report characterizes the vegetation and wildlife occuring at and near the site and describes the water quality and aquatic ecology of Bee Brook. No threatened or endangered plant or animal species are known to occur in the area, although suitable habitat exists for some species. The occurrence of a forested wetland north of the site is discussed. 9 refs., 2 figs.

31927 **(EGG-M—14187) Passive safety features of some recent fusion designs.** Piet, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-871007—91).

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The presence and effectiveness of passive safety features in six recent U.S. fusion designs are reviewed, namely the Compact Ignition Tokamak (CIT), Tokamak Ignition/Burn Experimental Reactor (TIBER), Tokamak Power Systems Study (TPSS), two TITAN Reverse Field Pinch (RFP) designs, and the Advanced Safe Pool Immersed Reactor (ASPIRE). The safety assurance level for these designs range from true inherent safety to requiring active safety systems. Much progress has been made, so that most designs appear to achieve some level of passive safety, intermediate between inherent safety and needing active systems. Key factors include material choice, cooling geometry and neutron wall loading. Advantages in one factor can compensate for disadvantages in another. For example, with selection of a pool geometry, the neutron wall loading may be safely increased. Consideration of investment protection is included with the safety assessments but is quite limited because of the difficulty of assessing what damage can be repaired. 11 refs., 7 tabs.

31928 **(GA-A—19238) The safety designs for the TITAN reversed-field pinch reactor study.** Wong, C.P.C.; Grotz, S.P.; Blanchard, J.; Cheng, E.T.; Sharafat, S.; Creedon, R.L.; Hoot, C.G.; Najmabadi, F.; Schultz, K.R. (General Atomics Co., San Diego, CA (USA); California Univ., Los Angeles (USA)). Mar 1988. Contract AC03-84ER53158. 12p. (CONF-880417—7).

From International symposium on fusion nuclear technology; Tokyo, Japan (10 Apr 1988).

TITAN is a study to investigate the potential of the reversed-field pinch concept as a compact, high-power density energy system. Two reactor concepts were developed, a self-cooled lithium design with vanadium structure and an aqueous solution loop-in-pool design, both operating at 18 MWm^2. The key safety features of the TITAN-I lithium-vanadium blanket design are in material selection, fusion power core configuration selection, lithium piping connections and passive lithium drain tank system. Based on these safety features and results from accident evaluation, TITAN-I can at least be rated as level 3 of safety assurance. For the TITAN-II aqueous loop-in-pool design, the key passive feature is the complete submersion of the fusion power core and the corresponding primary coolant loop system into a pool of low temperature water. Based on this key safety design feature, the TITAN-II design can be rated as level 2 of safety assurance. 7 refs., 2 figs.

31929 **(IPP—2/292) Electron cyclotron emission measurements during 28 GHz electron cyclotron resonance heating in Wendelstein WVII-A stellarator.** Hartfuss, H.J.; Gasparino, U.; Tutter, M.; Brakel, R.; Cattanei, G.; Dorst, D.; Elsner, A.; Engelhardt, K.; Erckmann, V.; Grieger, G.; WII-A Team; ECRH Group. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Nov 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753564/JAW.

Electron cyclotron emission measurements have been carried out on electron cyclotron resonance heated plasmas in the WENDELSTEIN VII-A Stellarator. Blackbody radiation from the thermalized plasma main body as well as radiation from a small amount of weakly relativistic suprathermal electrons has been detected. In addition sideband emission has been observed near the second harmonic of the heating line source. Harmonic generation and parametric wave decay at the upper hybrid layer may be a reasonable explanation.

31930 **(Juel—2142) Control of plasma position in TEXTOR tokamak applying a method of multipole moments of plasma current.** Kardon, B.; Soltwitsch, H.; Waidmann, G. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Jul 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753570/JAW.

On the basis of a method developed by Zakharov and Shafranov for the determination of the plasma cross section in toroidal geometry two special pick-up coils for the two components of the poloidal magnetic field were built. A cosine coil of higher order and a saddle coil were designed and installed outside the plasma column. The proper sum of these two signals permits the evaluation of the first momentum of the plasma current which is the equilibrium plasma displacement. The horizontal position of the plasma column was controlled on-line by the TEXTOR feedback system using this analog sum signal.

31931 **(LA-UR—88-443) A tritium-compatible piezoelectric valve for the tokamak fusion test reactor.** Coffin, D.O.; Cole, S.P.; Wilhelm, R.C. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 12p. (CONF-880505—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006467/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

This work describes modifications made to a commercial piezoelectric valve to make it sufficiently tritium compatible for the TFTR trritium injection scenario. The results of testing the valve for leakage and performance following a series of progressively more severe tritium exposures are also presented. Finally, a proposal for a totally radiation-compatible piezoelectric valve, suitable for tritium-burning fusion machines of the future, is decribed. 9 refs., 2 figs., 1 tab.

31932 **(LA-UR—88-672) A benchmark-problem specification and calculation using SENSIBL, a one- and two-dimensional sensitivity and uncertainty analysis code of the AARE system.** Muir, D.W.; Davidson, J.W.; Dudziak, D.J.; Davierwalla, D.M.; Higgs, C.E.; Stepanek, J. (Los Alamos National Lab., NM (USA); Paul Scherrer Inst., Wuerenlingen (Switzerland)). 1988. Contract W-7405-ENG-36. 15p. (CONF-880417—4).

From International symposium on fusion nuclear technology; Tokyo, Japan (10 Apr 1988).

The lack of suitable benchmark problems makes it difficult to test sensitivity codes with a covariance library. A benchmark problem has therefore been defined for one- and two-dimensional sensitivity and uncertainity analysis codes and code systems. The problem, representative of a fusion reactor blanket, has a simple, three-zone {tau}-z geometry containing a D-T fusion neutron source distributed in a central void region surrounded by a thick ^{6}LiH annulus. The response of interest is the ^{6}Li tritium production per source neutron, T_6. The calculation has been performed with SENSIBL using other codes from the AARE code system as a test of both SENSIBL and the linked, modular system. The caluclation was performed using the code system in the standard manner with a covariance data library in the COVFILS-2 format but modified to contain specifically tailored covariance data for H and ^{6}Li (Path A). The calculation was also performed by a second method which uses specially perturbed H and Li cross sections (Path B). This method bypasses SENSIBL and allows a hand calculation of the benchmark T_6 uncertainties. The results of Path A and Path B were total uncertainties in T_6 of 0.21% and 0.19%, respectively. The closeness of the results for this challenging test gives confidence that SENSIBL and the AARE system will perform well for realistic sensitivity and uncertainty analyses.

31933 **(LA-UR—88-870) Transportation of tritiated waste from fusion facilities.** Gruetzmacher, K.M.; Carlson, R.V.; Stencel, J.R.; Sissingh, R.A.P. (Los Alamos National Lab., NM (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.; Ontario Hydro, Toronto (Canada)). Mar 1988. Contract W-7405-ENG-36. 18p. (CONF-880505—8). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007886/JAW.

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications; Toronto, Canada (1 May 1988).

This paper examines methods of handling tritiated waste from a fusion facility, concentrating on handling requirements specific to tritium. Gaseous effluent from a fusion reactor can currently be transported from a fusion facility in two forms {endash} as a gas or solidified on uranium beds. Tritiated water can be transported if it is solidified by absorption onto molecular sieve beds or on clay or cement. Solid waste being shipped for disposal can be transported in low specific activity (LSA, less than 0.3 mCig[1.1 {times} 10^{7}Bqg]), type A (less than or equal to 1000 CI[3.7 {times} 10^{13}Bq]) or type B (greater than 1000 CI[3.7 {times} 10^{13}Bq]) standard containers. The method chosen for transport depends on the amount and level of activity of the tritiated material and whether or not it will be reprocessed at another facility. 4 refs., 4 figs., 4 tabs.

31934 **(LA-UR—88-897) The data collection system for failure/maintenance at the Tritium Systems Test Assembly.** Casey, M.A.;Gruetzmacher, K.M.;Bartlit, J.R.;Cadwallader, L.C. (Los Alamos National Lab., NM (USA); EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880505—9).

From 3. topical meeting on tritium technology in fission, fusion and isotopic applications;'Toronto, Canada (1 May 1988).

A data collection system for obtaining information which can be used to help determine the reliability and vailability of future fusion power plants has been installed at the Los Alamos National Laboratory's Tritium Systems Test Assembly (TSTA). Failure and maintenance data on components of TSTA's tritium systems have been collected since 1984. The focus of the data collection has been TSTA's Tritium Waste Tratment System (TWT), which has maintained high availability since it became operation in 1982. Data collection is still in progress and a total of 291 failure reports are in the data collection system at this time, 47 of which are from the TWT. 6 refs., 2 figs., 2 tabs.

31935 **(NAC—85-09) Design of stearing magnets for high- and low-energy beam lines.** Conradie, J.L.; Cornell, J.C. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Accelerator Centre). 1985. 52p. (In Afrikaans). CSIR, National Accelerator Centre, P O Box 72, Faure, 7131, South Africa.

The beam line between the injector cyclotron and the open sector cyclotron is known as an injection beam line or a low-energy beam line, and the beam lines to the open sector cyclotron are known as high-energy beam lines. Because of different reasons the beams on the low- and high-energy beam lines will deflect from the calculated circuit. Dipole magnets, called stearing magnets, are used to avoid these deflections. Because of the big difference in energy between the injection beam lines and high-energy beam lines, the design of the stearing magnets for the two beam lines will differ. This report discusses the design and construction of a prototype stearing magnet for each of the two beam lines.

31936 **(ORNL/FEDC—87/5) Thermal and mechanical analysis of the Faraday shield for the Compact Ignition Tokamak.** Vesey, R.A. (Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center). Feb 1988. Contract AC05-84OR21400. 40p.

The antenna for the ion cyclotron resonance heating (ICRH) system of the Compact Ignition Tokamak (CIT) is protected from the plasma environment by a Faraday shield, an array of gas-cooled metallic tubes. The plasma side of the tubes is armored with graphite tiles, which can be either brazed or mechanically attached to the tube. The Faraday shield has been analyzed using finite element codes to model thermal and mechanical responses to typical CIT heating and disruption loads. Four representative materials (Inconel 718, tantalum-10 tungsten, copper alloy C17510, and molybdenum alloy TZM) and several combinations of tube and armor thicknesses were used in the thermal analysis, which revealed that maximum allowable temperatures were not exceeded for any of the four materials considered. The two-dimensional thermal stress analysis indicated Von Mises stresses greater than twice the yield stress for a tube constructed of Inconel 718 (the original design material) for the brazed-graphite design. Analysis of stresses caused by plasma disruption ({rvec J} {times} {rvec B}) loads eliminated the copper and molybdenum alloys as candidate tube materials. Of the four materials considered, tantalum-10 tungsten performed the best for a brazed graphite design, showing acceptable thermal stresses (69% of yield) and disruption stresses (42% of yield). A preliminary thermal analysis of the mechanically attached graphite scheme predicts minimal thermal stresses in the tube. The survivability of the graphite tubes in this scheme is yet to be analyzed. 8 refs., 19 figs., 2 tabs.

31937 **(ORNL/TM—10419) Design and calibration of a two-channel low-noise heterodyne receiver for use in a CO_2 laser Thomson scattering alpha particle diagnostic.** Bennett, C.A.; Richards, R.K.; Hutchinson, D.P. (North Carolina Univ., Asheville (USA). Dept. of Physics; Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 17p.

A dual channel low noise heterodyne receiver has been constructed as part of a development effort to build a carbon dioxide laser based Thomson scattering alpha particle diagnostic for a burning plasma experiment. The receiver employs two wide bandwidth (>1 GHz) HgCdTe photovoltaic mixers followed by low noise IF amplifiers. A noise equivalent power of less than 3.0 {times} 10^{-20} WHz has been demonstrated. Design details and calibration methods are described. 8 refs.

31938 **(ORNL/TM—10644) Design considerations for a negative ion source for dc operation of high-power, multi-megaelectron-volt neutral beams.** Tsai, C.C.;Stirling, W.L.;Akerman, M.A.;Becraft, W.R.;Dagenhart, W.K.;Haselton, H.H.;Ryan, P.M.;Schechter, D.E.;Whealton, J.H. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 22p.

A dc negative hydrogen and/or deuterium ion source is needed to prouce high-power, high-energy neutral beams for alpha diagnostics and current drive applicatiosn in fusion devices. The favorable beam particle energy for such applications extends to 1.5

MeV/amu. Continuous-wave (cw) radio-frequency quadrupole (RFQ) accelerators have been proposed to accelerate negative ions effeciently to this energy range. In this paper, the desired beam properties for ion beams injected into cw RFQ accelerators are summariezed. A number of candidate ion sources being developed at Culham, JAERI, LBL, and ORNL may prove useful for these applications. The properties of the Volume Ionization with Transverse Extraction (VITEX) ion sources being developed at ORNL are presented. Scaling such a dc ion source to produce ampere beams is discussed. 53 refs., 4 figs., 2 tabs.

31939 **(ORNL/TM—10660) Electronic implementation of a closed-loop gas-flow control system.** Moore, J.A. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 53p.

The fast gas-injection system on the ISX Tokamak at Oak Ridge National Laboratory injects controlled amounts of impurity gases into a hydrogen plasma to study particle transport physics within the plasma. Since for a given discharge the plasma lasts only a fraction of a second at near vacuum pressures, fast, accurate control of the impurity injection rate is essential for discharge stability and meaningful quantitative analysis. The gas-injection control system in place on this experiment exhibited excessive drift, poor maintainability, and limited versatility. This report investigates the design of an improved electronic control system featuring higher loop gain, automatic drift cancellation, high reliability and maintainability, fault protection, and increased versatility through computer control. The circuitry designed for this system exhibits negligible electronic noise and drift while providing repeatable response on a millisecond time scale. Unconditional stability and graceful recovery from saturation have been observed. Problems with noise intrusion and thermal sensitivity remain. Further development will be required before an operational system can be fabricated. 6 refs., 20 refs.

31940 **(ORNL/TM—10669) Theoretical study of the folded waveguide.** Chen, G.L.;Owens, T.L.;Whealton, J.H. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 21p.

We have applied a three-dimensional (3-D) algorithm for solving Maxwell's equations to the analysis of foleded waveguides used for fusion plasma heating at the ion cyclotron resonance frequency. A rigorous analysis of the magnetic field structure in the folded waveguide is presented. The results are compared to experimenntal measurements. Optimum conditions for the folded waveguide are discussed. 6 refs., 10 figs.

31941 **(ORNL/TM—10720) Compact toroid refueling of reactors.** Gouge, M.J.; Hogan, J.T.; Milora, S.L.; Thomas, C.E. (Oak Ridge National Lab., TN (USA)). Apr 1988. Contract AC05-84OR21400. 11p.

The feasibility of refueling fusion reactors and devices such as the International Thermonuclear Engineering Reactor (ITER) with high-velocity compact toroids is investigated. For reactors with reasonable limits on recirculating power, it is concluded that the concept is not economically feasible. For typical ITER designs, the compact toroid fueling requires about 15 MW of electrical power, with about 5 MW of thermal power deposited in the plasma. At these power levels, ideal ignition ($Q = \infty$) is not possible, even for short-pulse burns. The pulsed power requirements for this technology are substantial. 6 ref., 1 figs.

31942 **(ORNL/TM—10756) The ORNL Advanced Toroidal Facility: Physics insight leads to efficient computer-aided construction.** Whitson, J.C.; Rome, J.A. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 15p.

A method for accurate measurement of complex parts that contain no reference points is described. The technique is applied to the production of accurate castings, to their machining, and to their installation. Accuracies of {approximately} 2 mil can be achieved over distances of 7 ft. 3 figs.

31943 **(PPPL—2485) Force-free coil principles applied to high-temperature superconducting materials.** Furth, H.P.; Jardin, S.C.; Montgomery, D.B. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Nov 1987. Contract AC02-76CH03073. 12p.

Force-free magnetic-field configurations, where the current flows parallel to the magnetic field vector, have the potential to raise the critical magnetic field and current-density limits for high-temperature superconductors. 10 refs., 3 figs.

31944 **(RISO-M—2650) Investigation of pellet acceleration by an arc heated gas gun.** Andersen, P.; Andersen, S.A.; Bundgaard, J.; Baekmark, L.; Hansen, B.H.; Jensen, V.O.; Kossek, H.; Michelsen, P.K.; Nordskov, A.; Sass, B. (Risoe National Lab., Roskilde (Denmark)). Jun 1987. 52p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88753016/JAW.

This report describes work on pellet acceleration by means of an arc heated gas gun. The work is a continuation of the work described in RISO-M-2536. The aim of the work is to obtain velocities well above 2 km/s for 3.2 mm diameter deuterium pellets. By means of a cryogenic arc chamber in which the hydrogen propellant is pre-condensed, extruded deutetrium pellets are accelerated up to a maximum velocity of 1.93 km/s. When increasing the energy input to the arc in order to increase the pellet velocity further the heat input to the extrusion/punching pellet loading mechanism was found to be critical: preparation of pellets became difficult and cooling times between shots became inconveniently long. In order to circumvent this problems the concept of a room temperature hydrogen propellant pellet fed arc chamber was proposed. Preliminary results from acceleration of polyurethane pellets with this arc chamber are described as well as the work of developing of feed pellet guns for this chamber. Finally the report describes design consideration for a high pressure propellant pellet fed arc chamber together with preliminary results obtained with a prototype arc chamber.

31945 **(RISO-M—2678) Effect of ablatant composition on the ablation of a fuelling pellet.** Chang, C.T.; Thomsen, K.; Piret, S. (Risoe National Lab., Roskilde (Denmark)). Jan 1988. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88753020/JAW.

The single species neutral-shielding model for the ablation of a hydrogenic pellet is extended by considering the ablatant as a mixture of four species: molecular and atomic hydrogen, protons and electrons. Compared with the results of the frozen flow, (i.e. the single species molecular hydrogen gas model), results of the analysis showed that the presence of dissociation and ionization effects caused a marked difference of the ablatant state. The attenuations of the incoming electron energy and energy flux, however, are very much similar irrespective of whether the ablated flow is in a frozen or an equilibrium state. The scaling law of the pellet ablation rate with respect to the plasma state of Te, ne and the pellet radius remains the same; the ablation rate is reduced by approximately 15%. To examine the possible existence of a spherical shell around the pellet where most of the incoming electron energy is absorbed, acodmparison is made between the local electron collisional mean free path and the electron Larmor radius. A critical field at the ionization radius is evaluated. An effective spherical energyabsorbing region exists when the local field strength is below the critical value. For a plasma state of low Te and ne, (where the ablatant is hardly ionized), and for one near the thermonuclear condition (where a highly dense ablatant exists near the pellet), the effective energy absorption region is nearly spherical. 20 refs.

31946 **(SAND—87-0313) Vaporization studies of plasma interactive materials in simulated plasma disruption events.** Stone, C.A. IV; Croessmann, C.D.; Whitley, J.B. (California Univ., Los Angeles (USA). School of Engineering and Applied Science; Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 47p.

The melting and vaporization that occur when plasma facing materials are subjected to a plasma disruption will severely limit component lifetime and plasma performance. A series of high heat

flux experiments was performed on a group of fusion reactor candidate materials to model material erosion which occurs during plasma disruption events. The Electron Beam Test System was used to simulate single disruption and multiple disruption phenomena. Samples of aluminum, nickel, copper, molybdenum, and 304 stainless steel were subjected to a variety of heat loads, ranging from 100 to 400 msec pulses of 8 to 18 kWcm^2. It was found that the initial surface temperature of a material strongly influences the vaporization process and that multiple disruptions do not scale linearly with respect to single disruption events. 2 refs., 9 figs., 5 tabs.

31947 (SAND—87-2116C) PBFA II progress and plans. Cook, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 14p. (CONF-871093—6). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007606/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

Considerable progress has been made on the Particle Beam Fusion Accelerator II (PBFA II) since the first shot was taken in December 1985. The 36 Marx generators, which store 12 MJ, have proven to be very reliable and are routinely synchronized better than the 40-ns design goal. The water-dielectric pulse-forming section has provided 2.9 MJ in a 55-ns pulse. A total energy of 2.2 MJ has been stored in the magnetically-insulated vacuum inductive voltage adder situated between the pulse forming section and the diode load. An energy of 1.3 MJ, or more than 10% of the energy stored in the Marx genertors, has been coupled to a blade electron load. Calculated peak open circuit voltages of 22 MV and measured peak short circuit currents of 6.4 MA have been obtained. Recently, synchronization of the 36 pulse-forming modules was imporved substantially by modifications made to the laser-triggered gas switches. First-to-last (i.e., total) module timing spread is now routinely less than 20 ns for 36-module shots and less than 10 ns for 18-module shots. These achievements have made PBFA II a very powerful laboratory tool for studying the phsyics of ion beam generation, ion beam focusing, and target interaction experiments. 40 refs.

31948 (SAND—87-3097C) Time-resolved visible spectroscopy of laser-produced lithium plasmas. Bailey, J.; Tisone, G.C.; Hurst, M.J.; Morrison, R.L.; Bieg, K.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880364—10).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

We have measured time-resolved visible spectra emitted from a plasma formed when the output from a dye laser irradiates solid lithium. Such a plasma has potential as a source of lithium ions for ion-driven inertial confiement fusion, and it also provides a useful source for developing diagnostics. The laser delivered 0.5 Joules onto a 2-7 mm diameter spot, with a 900-ns pulse length. Experiments were performed with the wavelength tuned to the Li I 2s-2p resonance line at 6708 {angstrom} and off-resonance at 6728 {angstrom}. The target was a 500 to 1000 {angstrom} thick Li film, vacuum evaporated in situ onto a substrate. The light from the plasma was coupled into the entrance slit of a 1-m Czerny-Turner spctrometer, and the output from the spectrometer was focused onto the input slit of a steak camera. The electron density was obtained from Stark broadened widths of Li I 2p-4d, 2p-5d, 2p-4s, and H I 2p-4d. An irradiance of 2 x 10^6 wcm^2 at 6708{angstrom} resulted in a peak electron density of 3.9 x 10^{17} cm/sup {minus/3}. The density decreased at lower irradiance, with an intensity threshold of 5 x 10^5 Wcm^2 for producing an ionized plasma. The threshold for producing a plasma was higher with the laser tuned off resonance, although high density lithium plasmas could still be formed at relatively lower laser irradiance. 6 refs., 4 figs.

31949 (SAND—87-3098C) Intense ion beam K-alpha measurements on PBFA-II. Maenchen, J.; Mehlhorn, T.A.; Wenger, D.F.; Leeper, R.J.; Johnson, D.J.; Lockner, T.R. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 17p. (CONF-880364—2). NTIS, PC A03/MF A01;1; GPO Dep. Order Number DE88007280/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Inertial Confinement Fusion research efforts at Sandia National Laboratories center around generating and focusing high intensity light ion beams on the Particle Beam Fusion Accelerator PBFA-II. A time-integrating three-frame ion beam spatial monitor was developed for these experiments to determine proton and lithium ion beam uniformity and orbit characteristics by imaging the ion-induced K-alpha line radiation. The three views of the ion beam are made off-axis in three diode quadrants at a 3.8 cm radius. This spatial monitor, in conjunction with other beam diagnostics, allows experimenters to determine the high voltage focusing characteristics of the ion diode. 16 refs., 5 figs.

31950 (SAND—87-3120C) Rutherford magnetic spectrograph for intense ion beam measurements on PBFA II. Leeper, R.J.; Stygar, W.A.; Kensek, R.P.; Lee, J.R.; Johnson, D.J.; Lockner, T.R.; Maenchen, J.; Hebron, D.E.; Wenger, D.F. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 15p. (CONF-880364—1).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

A time-resolved magnetic spectrograph employing a gold Rutherford scattering foil has been constructed to measure the parameters of the intense ion beams generated by Sandia National Laboratories' PBFA-II accelerator. The spectrograph operates by allowing the direct intense beam of PBFA II to scatter from a thin gold foil to reduce its intensity for magnetic analysis. Details of the spectrograph's construction, detector package and recent PBFA-II proton data are included in the paper. 7 refs., 5 figs.

31951 (SAND—87-3125C) The XRD [x-ray diode] array, the grazing incidence spectrometer, and the x-ray imaging camera on PBFA II. Derzon, M.S.;Sweeney, M.A.;Grandon, P.;Ives, H.C.;Kensek, R.P.;Mix, L.P.;Stygar, W.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 17p. (CONF-880364—3).

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Target diagnostics on PBFA II will include a time-resolved x-ray diode array, an energy-resolved, time-integrated x-ray camera and a grazing incidence spectrometer. A clean vacuum, independent of that on PBFA II, will be supplied to the detectors to maintain more reproducible calibrations. We also describe the diagnostics and outline the calculations which determined the shielding required. Based on the calculations the background due to bremsstrahlung in the least sensitive diagnostic is 12 eV/pixel. The appropriate shielding is being built to field these diagnostics. 8 refs., 6 figs., 1 tab.

31952 (SAND—87-3152C) Simulation and interpretation of ion beam diagnostics on PBFA-II. Mehlhorn, T.A.;Nelson, W.E.;Maenchen, J.E.;Stygar, W.A.;Ruiz, C.L.;Lockner, T.R.;Johnson, D.J. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 15p. (CONF-880364—8). NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88007582/JAW.

From 7. topical conference on high temperature plasma diagnostics; Napa, CA, USA (13 Mar 1988).

Ion diode and beam focusing experiments are in progress on PBFA-II working towards an ultimate goal of significant burn of an ICF pellet. Beam diagnostics on these experiments include a Thomson parabola, K/sub alpha/ x-ray pinhole cameras, filtered ion pinhole cameras, and a magnetic spectrometer. We are developing two new computer programs to simulate and interpret the data obtained from these diagnostics. VIDA is a VAX-based program that manipulates and unfolds data from digitized particle and x-ray diagnostic images. VIDA operations include: image display, background substraction, relative-to-absolute coordinate transformations, and image projection into the beam reference frame. PICDIAG allows us to study the effects of time-dependent ion focusing on the performance of ion beam diagnostics. 10 refs., 5 figs.

31953 (SAND—88-0625C) Field-enhanced lithium ion sources for PBFA II. Stinnett, R.W.; Olson, R.E.; Dritt, J.O.; Bieg, K.W.; Gerber, R.A.; McKay, P.F.; Panitz, J.A.; Pregenzer, A.L.; Woodworth, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880687—2).

From 13. international symposium on discharges and electrical insulation in vacuum; Paris, France (27 Jun 1988).

Inertial Confinement Fusion (ICF) experiments at 30 MeV on the Particle Beam Fusion Accelerator (PBFA) II at Sandia National Laboratories will require the use of high intensity, high purity beams of singly ionized lithium ions. One approach which is being tested to produce such beams is the use of field-enhanced lithium ion sources. We have identified several ion production mechanisms which may be active in this source. 8 refs., 2 figs.

31954 (UCID—21329) The DIII-D summary contribution to the final INTOR workshop. Hill, D.N.; Allen, S.L.; Brooks, N.H.; Content, D.; DeBoo, J.C.; Gohil, P.; Haas, G.; Heifetz, D.; Hsieh, D.; Hulse, R.A.; Jackson, G.L.; Lao, L.; Mahdavil, M.A.; Mayberry, M.J.; Ohyabu, N.; Perkins, D.E.; Perry, M.E.; Petrie, T.W.; Rensink, M.E.; Scoville, T.; Shimada, M.; Snider, R.T.; Stockdale, R.E.; Wood, R.D. (Lawrence Livermore National Lab., CA (USA); General Atomics Co., San Diego, CA (USA); Johns Hopkins Univ., Baltimore, MD (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Princeton Univ., NJ (USA). Plasma Physics Lab.; Japan Atomic Energy Research Inst., Tokyo). 26 Feb 1988. Contract W-7405-ENG-48. 21p. NTIS, PC A; 03/MF A01; GPO Dep. Order Number DE88008021/JAW.

In SIII-D, good H-mode confinement has been obtained with up to 6 MW of neutral-beam injection (NBI). In this report we summarize the essential features of divertor operation for DIII-D H-mode plasma. Briefly, our measurements show that: Large edge density and temperarture gradients are obtained with scale lengths of a few cm at the midplane; In the steady state, approximately 10-20% of the input power is deposited on the divertor plates in a region that is peaked on the separatrix and extends radially over {approx equal} 2-4 cm at the outboard intercept. More power (2:1) reaches the outboard intercept than the inboard; Low electron temperature (≦20eV) and high density (n/sub e//sup div/ {approx equal} n/sub e//sup main/ ≧ 3-10 {times}10^{19} m^{-3} at the divertor plates indicate that DIII-D obtains a high-recycling divertor during H-mode. DEGAS neutral transport modeling is consistent with these results; The duration of good H-mode confinement is limited by Edge Localized Modes (ELMs) rather than increasing impurity radiation; The dominant impurities, C and Ni are concentrated in the edge plasma (ra ≧ 0.5) for I/sub p/ ≧ 1 MA; and Global impurity concentrations fall markedly with increasing plasma current. The remainder of this report contains a brief description of the DIII-D tokamak and the relavant diagnostics, a summary of the divertor plasma parameters obtained during the H-mode and the heat loads on the diverotr target plates. The results of measurements of the central radiation and impurity content using data from an EUV spectrometer and a 21 channel bolometer array are discussed, and finally a discussion of the implication of these results for the CIT and ITER tokamak designs is given. 8 refs., 8 figs.

31955 (UCRL—98386) Simultaneously time- and space-resolved spectroscopic characterization of laser-produced plasmas. Charatis, G.; Young, B.K.F.; Busch, G.E.; Cerjan, C.J.; Goldstein, W.H.; Osterheld, A.L.; Phillips, T.W.; Rosen, M.D.; Stewart, R.E.; Walling, R.S. (KMS Fusion, Inc., Ann Arbor, MI (USA); Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Applied Science). 3 Mar 1988. Contract W-7405-ENG-48. 7p. (CONF-880110—26).

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The CHROMA laser facility at KMS Fusion has been used to irradiate a variety of microdot targets. These include aluminum dots and mixed bromine dots doped with K-shell (magnesium) emitters. Simultaneously time- and space-resolved K-shell and L-shell spectra have been measured and compared to dynamic model predictions. The electron density profiles are measured using holographic interferometry. Temperatures, densities, and ionization distributions are determined using K-shell and L-shell spectral techniques. Time and spatial gradients are resolved simultaneously using three diagnostics: a framing crystal x-ray spectrometer, an x-ray streaked crystal spectrometer with a spatial imaging slit, and a 4-frame holographic interferometer. Significant differences have been found between the interferometric and the model-dependent spectral measurements of plasma density. Predictions by new non-stationary L-shell models currently being developed are also presented. 14 refs., 10 figs.

31956 Three-barrel repeating pneumatic pellet injector for plasma fueling of the Joint European Torus. Combs, S.K.; Milora, S.L.; Baylor, L.R.; Foust, C.R.; Gethers, F.E.; Sparks, D.O. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1901-1904(May 1988).

A three-barrel repeating pneumatic pellet injector has been developed for plasma fueling of the Joint European Torus (JET) tokamak. The versatile device consists of three independent machine-gun-like mechanisms that operate at cryogenic temperatures (10—20 K). Individual extruders provide a continuous supply of solid hydrogen isotope to each gun assembly, where a reciprocating breech-side cutter forms and chambers cylindrical pellets from the extrusion; the deuterium pellets are then accelerated in the gun barrels with compressed hydrogen gas (pressures up to 105 bar) to velocities ≦1.5 km/s. The injector features three nominal pellet sizes (2.7, 4.0, and 6.0 mm) and repetitive operation (5, 2.5, and 1 Hz, respectively) for quasi-steady-state conditions (>10 s). The design allows the gun barrels to be aligned mechanically for accurate aiming. A remote stand-alone control and data acquisition system is used for injector operation. The injector system has been installed on JET. The design features, operation, and performance characteristics of the injector are described.

31957 Deposition rate dependence of plasma polymerization on the radius of curvature of the substrate. Lintz, H.K.; Murrell, S.R.; Crawley, R.L.; Daukas, J.C. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1869-1871(May 1988).

In the plasma polymerization deposition of CH/sub x/ onto microspherical inertial fusion targets we have found that the coating rate varies with substrate diameter. Spherical shells ranging in diameter from 100 to 1000 μ were coated with several microns of plasma polymerized trans-2-butene under identical conditions and their coating thicknesses measured interferometrically. We found that the coating rate variation with shell radius could be described by an equation having the form drdt = A(R+r)+B, where drdt is the coating rate, R the initial sphere radius, r the coating thickness, and A and B parameters related to the plasma conditions. We also found that there exists a functional relationship between the parameters A and B which is dependent on the rf power density. A model has been developed to show how this observed rate dependence relates to the buildup of an electrical charge on the nonconducting substrate surface. The electric field which arises is dependent on the radius of curvature of the substrate and in turn affects the contribution to the film growth by the ionized species impinging upon the surface. Neutral species arriving at the surface are not affected and thus lead to the B term in the empirical form of the rate dependence.

31958 Analysis of the thermally induced formation of a uniform liquid layer of ternary deuterium—tritium mixture inside a cryogenic spherical shell inertial confinement fusion target. Varadarajan, V.; Kim, K.; Bernat, T.P. (Fusion Technology Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 3, 1876-1881(May 1988).

The values of the externally applied thermal gradients that give rise to uniform liquid layers of a ternary deuterium—tritium mixture inside a cryogenic spherical shell inertial confinement fusion target are calculated using a model recently developed by

the authors. It is shown that the surface tension gradients induced by the component separation at the liquid—vapor interface pull the liquid upward, thus counteracting the gravity-induced fuel sagging and forming dynamically stable uniform liquid layers. The governing equations are the equations of continuity, momentum, energy, and mass diffusion—convection, which are solved using finite-difference methods. The solutions indicate that one needs fairly large positive thermal gradients, obtained by keeping the top of the target warmer than the bottom, in order to create uniform liquid layers on the inner surface of the target.

31959 **Real-time holographic interferometry technique for measuring cryogenic fuel layers in large inertial confinement fusion targets.** Pattinson, T.R.; Felmlee, W.J. (KMS Fusion, Inc., Ann Arbor, Michigan 48106). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1882-1884(May 1988).

We have recently installed a real-time holographic interferometry system on one of our experimental vacuum chambers. This system, which utilizes an argon laser at 488.0 nm and a Newport Research HC-300 holographic camera, will be used to develop and document liquid layer targets for inertial confinement fusion experiments. An interference image is produced when the image of a liquid layer target is superimposed on the stored holograph of the same target with the fuel held in the gas phase. This real-time interference image is due to the change in the fuel state and is a direct measure of the liquid layer uniformity. Routine use of this imaging system will allow us to develop the techniques needed to produce acceptable liquid layers in targets 1—2 mm in diameter with walls 5—50 μm thick. We will discuss the techniques and configuration used to adopt this system for the vibration noise inherent in an experimental chamber.

31960 **Helium cryopumping for fusion applications.** Sedgley, D.W.; Batzer, T.H.; Call, W.R. (Grumman Corporation, Bethpage, New York 11714). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1209-1213(May 1988).

Large quantities of helium and hydrogen isotopes will be exhausted continuously from fusion power reactors. This paper summarizes two development programs undertaken to address vacuum pumping for this application: (i) A continuous duty cryopump for pumping helium and/or hydrogen species using charcoal sorbent and (ii) a cryopump configuration with an alternative shielding arrangement using charcoal sorbent or argon spray. A test program evaluated automatic pumping of helium, helium pumping by charcoal cryosorption and with argon spray, and cryosorption of helium/hydrogen mixtures. The continuous duty cryopump pumped helium continuously and conveniently. Helium pumping speed was 7.7 l/s/cm² of charcoal, compared to 5.8 l/s/cm² for the alternative pump. Helium speed using argon spray was 18% of that obtained by charcoal cryosorption in the same (W-panel) pump. During continuous duty cryopump mixture tests with helium and hydrogen copumped on charcoal, gas was released sporadically. Testing was insufficient to explain this unacceptable event.

31961 **Leak detection on the DIII-D tokamak using helium entrainment techniques.** Brooks, N.H.; Baxi, C.; Anderson, P. (GA Technologies Inc., San Diego, California 92138). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1222-1225(May 1988).

The entrainment of helium in a viscous gas flow was utilized to compartmentalize, and then to pinpoint, a leak across the inner skin of the double-walled DIII-D vacuum vessel. Inaccessible from the outside, the leak connected the cooling channels in the wall interspace with the primary vacuum chamber. By entraining helium in the pressurized flow from the single-pass gas circulation system, well-defined portions of the wall were exposed to helium without disassembly of the poorly accessible cooling manifolds. Varying the helium injection point permitted the localization of the leak to a single 30° toroidal sector of the vessel. The exact location of the leak was found from inside the vessel by spraying helium on suspect regions, while sweeping the contents of the cooling channels to the foreline of a Varian Contraflow leak detector with a 0.1 Pa m³/s flow of nitrogen. Flow speed calculations were used to predict the response time to entrained helium of the actual leak detection setup.

31962 **Vacuum vessel heating system for the Advanced Toroidal Facility.** Langley, R.A.; Neilson, G.H.; Alban, A.M.; Slaughter, E.; Sumner, J.N.; White, J.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 1288-1292(May 1988).

An 80-kW system for heating the Advanced Toroidal Facility (ATF) stainless-steel vacuum vessel to 150 °C, the design limit of the vessel, has been designed. The system's primary purpose is to accelerate the outgassing of the vessel walls during the initial pumpdown following an opening to atmospheric pressure. It will also measure the thermal time constant of the vessel. These measurements are important for assessing the vessel's power-handling capability. The main body of the vessel is induction heated by applying 440-V, 60-Hz power directly to the main torsatron windings. The eddy currents that this power induces in the vessel produce an estimated 50 kW of joule heating. The vacuum vessel temperature is measured with an array of thermocouples. A programmable logic controller regulates the temperature and provides interlock and overheating protection. A system of 60 heating tapes, each rated at 520 W, is installed on the ports and ducts attached to the vessel. This system, in conjunction with the induction heating system, is planned to provide temperature uniformity. The total heating power and rates of rise and fall of the vessel temperature have been calculated using a model of the vacuum vessel. The results are given.

31963 **Particle balance in the Tokamak Fusion Test Reactor.** Ulrickson, M.; Dylla, H.F.; LaMarche, P.H.; Buchenauer, D. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 2001-2003(May 1988).

Plasma particle pumping effects with carbon limiters have been seen inTokamak Fusion Test Reactor (TFTR), Joint European Torus (JET), and TorusExperiment for Technology Oriented Research (TEXTOR). The pumping effects inTFTR were induced by conditioning the large-area axisymmetric bumper limiter with low-density, helium initiated discharges. As a result of the conditioning ~150 Torr l of gas are removed from the carbon limiter tiles. The conditioning has reduced the particle recycling coefficient from near unity to values as low as 0.5. The low recycling conditions are not permanent. A pumping capacity of ~100 Torr l has been determined from wall loading experiments. The total particle input has been compared to the total outgassing after a discharge for Ohmic plasmas in both helium and deuterium, and for deuterium neutral beam heated discharges. Ohmic deuterium plasmas have less outgassing than input. Ohmic helium plasmas have equal or greater outgassing compared to gas input. Neutral beam heated discharges have a slight deficit in outgassing, but it is much less than that for Ohmic shots. The low recycling conditions last much longer with neutral beams than in Ohmic discharges. The limiter pumping effect and the reduction in recycling is a prerequisite for the enhanced confinement neutral beam heated discharges observed on TFTR.

31964 **Analysis of self-regenerating coatings for pulsed-mode fusion plasma operation.** DeWald A.B. Jr.; Krauss, A.R.; Lam, N.Q. (Corium Industries Inc., Atlanta, Georgia 30318). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 2125-2129(May 1988).

One promising approach to the fusion plasma impurity and material erosion associated with surfaces subject to high heat/particle fluxes has been the development of strongly segregating alloy systems capable of producing self-sustaining low-Z coatings. Previous plasma-material analyses of self-regenerating alkali-metal-bearing alloys such as Cu—Li and Al—Li and proposed ternary refractory composites have focused on the steady-state regime of advanced engineering tokamak designs without addressing adequately the pulsed-mode operation of present and planned near-term magnetic confinement devices. The survivability of "regenerative" coatings is coupled directly to thermal and radiation diffusion/segrega-

tion defect fluxes induced in the material by the plasma pulse. The lithium solute transport in Al—Li and Cu—Li alloys has been modeled as a function of the operational cycle, plasma-edge temperature, lithium secondary-ion fraction, and alloy composition. The pulse duration has been varied in order to investigate related transient effects upon the buildup and decay of the alkali-metal segregation and diffusion. Pulse widths ranging from 25 ms to 2.5 s have been chosen to simulate magnetic confinement fusion devices.

31965 **Imaging of tritium implanted into graphite.** Malinowski, M.E.; Causey, R.A. (Physical Research Division, Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 6: No. 3, 2130-2135(May 1988).

The extensive use of graphite in plasma-facing surfaces of tokamaks such as the Tokamak Fusion Test Reactor, which has planned tritium discharges, makes two-dimensional tritium detection techniques important in helping to determine torus tritium inventories. We have performed experiments in which highly oriented pyrolytic graphite (HOPG) samples were first tritium implanted with fluences of $\sim 10^{16}$ T/cm^2 at energies approx. <25 eV and then the near-surface implant distributions were detected in two dimensions using tritium imaging. A portion of the sample was masked off during the implant in order to produce a well-defined implant boundary. Heating of the HOPG samples to temperatures as high as 500 °C resulted in no discernible motion of tritium along the basal plane, but did show that significant desorption of the implanted tritium occurred. The current results indicate that tritium in quantities of 10^{12} T/cm^2 in tritiated components could be readily detected by imaging at lower magnifications.

31966 **(DP-TR—106) In-pile test of tritium release from tritium breeding materials (VOM-21H experiment): Tritium release and behavior from lithium oxide.** Kurasawa, T.; Takeshita, H.; Yoshida, H.; Watanabe, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki). 1988. Contract AC09-76SR00001. Translation of JAERI-M-86-152, 30 SEP 1986. 92p.

Material development and blankets design of lithium-based ceramics such as lithium oxide, lithium aluminate, lithium silicate and lithium zirconate have been performed in Japan, United State of America and Europian Communities. Lithium oxide is a most attractive candidate for tritium breeding materials because of its high lithium density, high thermal conductivity and good tritium release performance. This work has been done to clarify the characteristics of tritium release and recovery from Li/sub 2]O by means of in-situ tritium release measurement. The effects of temperature and sweep gas composition on the tritium release were investigated in this VOM-21H Experiment. Good measurement of tritium release was achieved but there were uncertainties inreproducibility of data. The experimental results show that the role of surface adsorption/desorption makes a significant contribution to the tritium release and tritium inventory. Also, it is necessary to define the rate limiting process either diffusion or surface adsorptiondesorption. 20 refs.

99 GENERAL AND MISCELLANEOUS

31967 **(DOE/MA—0335) Listing of awardee names: Retired awards as of April 5, 1988.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 1988. 940p.

This is a computerized listing issued semiannually from the Procurement and Assistance Data System, including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with DOE. (DLC)

31968 **(DOE/SR/10749—T1) Synthesis of historical archaeological sites on the Savannah River Plant, Aiken and Barnwell Counties, South Carolina.** Brooks, R.D. (South Carolina Univ., Columbia (USA). Inst. of Archeology and Anthropology). 1988. Contract AC09-81SR10749. 96p.

The object of this report is to provide historical synthesis of the Savannah River Plant region integrated with the historical archeological record. The first chapter discusses the historic research concerns of the Savannah River Archaeological Research Program, the Physical Geography of the Savannah River Plant in regard to climate, coil, and vegetation, and the Human Geography of the region. Chapter 2 presents the Chronology of historic sites from the archarological record on the Savannah River Plant. Chapter 3 discusses the Settlement of the Savannah River Valley and the Agricultural Land use on the Savannah River Plant. Chapter 4 presents the results of historic research into the Mill Dams located on the Savannah River Plant their political importance and location. Chapter 5 discribes the Archaeological Methodology used and the Archaeological Resources of the Savannah River Plant. Chapter 6 present the Conclusions and Recommendations of the Savannah River Plant Archaeological Research Program in regards to the historical archeological sites on the Savannah River Plant. 80 refs., 13 figs., 23 tabs.

31969 **(DP-MS—88-1) Creating a word list for technical and clerical personnel.** Hammond, J.S. (Savannah River Lab., Aiken, SC (USA)). May 1988. Contract AC09-76SR00001. 4p. (CONF-880528—3).

From 35. annual international technical communication conference; Philadelphia, PA, USA (10 May 1988).

The Savannah River Plant and Laboratory employ more than 16,000 people. When the separate Publications Divisions of the Plant and Laboratory were combined it was determined that a single source of information for using terms was needed, and that the source would take the form of a word list. The Word List was issued to more than 5000 employees onsite. In addition, the Word List is being added to the site computer network as a reference document and as an online spelling checker where more than 2000 employees will have access to it through their personal computers.

31970 **(LA—11247-MS) Human collective dynamics: Two groups in adversarial encounter.** Sandoval, D.L.; Harlow, F.H.; Genin, K.E. (Los Alamos National Lab., NM (USA)). Apr 1988. Contract W-7405-ENG-36. 69p.

The behavior of a group of people depends strongly on the interaction of personal (individual) traits with the collective moods of the group as a whole. We have developed a computer program to model circumstances of this nature with recognition of the crucial role played by such psychological properties as fear, excitement, peer pressure, moral outrage, and anger, together with the distribution among participants of intrinsic susceptibilities to these emotions. This report extends previous work to consider two groups of people in adversarial encounter, for example, two platoons in battle, a SWAT team against rioting prisoners, or opposing mobs of different ethnic backgrounds. Closely related applications of the modeling include prowling groups of predatory animals interacting with herds of prey, and even the "slow-mob" behavior of social or political units in their response to legislative or judicial activities. Examples in this present study emphasize battlefield encounters, with each group characterizzed by its susceptibilities, skills, and other manifestions of both intentional and accidental circumstances. Specifically, we investigate the relative importance of leadership, camaraderie, training level (i.e. skill in firing weapons), bravery, excitability, and dedication in the battle performance of personnel with random or specified distributions of capabilities and susceptibilities in these various regards. The goal is to exhibit the probable outcome of these encounters in circumstances involving specified battle goals and distributions of terrain impediments. A collateral goal is to provide a real-time hands-on battle simulator into which a leadership trainee can insert his own interactive command.

31971 **(ORAU—87/1-91) TRADE [Training Resources and Data Exchange] technical training programs inventory: Volume IV, Craft programs, miscellaneous programs.** (Oak Ridge Associated Universities, Inc., TN (USA)). Oct 1987. Contract AC05-76OR00033. 110p.

In a continuing effort to facilitate communications and resource exchange among the DOE contractors, the TRADE (Training Resources and Data Exchange) Committee composed of representatives from 10 DOE contractors, has compiled the Training Programs Inventories. Taken together there are over 2700 courses that reflect the range and focus of in-house training programs being offered throughout the DOE GOCO system by approximately 49 contractors. The Technical Training Programs Inventories include

those programs or courses designed specifically for in-house employees and which provide development and practical information about job-related subjects not included in the nontechnical training area. The focus of the Inventories has been on targeted audiences, resources, and course design. The contact person has been listed with each course to encourage the use of the inventories and facilitate the excchange of information between GOCOs through a peer-to-peer exchange between training personnel of various contractors. This publication contains 140 courses focusing on crafts programs and miscellanous programs at all levels. Information of the inventories is available on the DOE Integrated Technical Information System (ITIS) as the TRD file.

31972 (ORNL/DSRD/TM—12) **Non-validation of Lanchester's original equations in the Inchon-Seoul campaign of the Korean War.** Hartley, D.S. III. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 20p.

Daily attrition in the Inchon-Seoul campaign of the Korean War is analyzed using statistical mewthodology. This method yields a numerical measure of the goodness of fit and a measure of the statistical significance of the fit as opposed to the visual measure used previously. It also provides information as to reasons for poor fit. Neither Lanchester's Square Law Equations, nor his Linear Law Equation, provide statistically significant explanations of the course of the attrition in this battle. Their failure together with the modifications of the data which improve the fit imiply that other factors besides numerical strengths must be considered. While the data is insufficient to provide reliable determinants for these factors, the extent to which the fit can be improved supports the heuristic attrition equations used in most modern models. 13 refs., 4 figs., 3 tabs.

31973 (SAND—88-0224) **Primary Standards Laboratory report: 2nd half 1987.** W.G.T. Levy (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 25p. NTIS, PC A03/MF A01; GPO Dep. Order Number TI88008004/JAW.

Sandia National Laboratories operates the Primary Standards Laboratory (PSL) for the Department of Energy, Albuquerque Operations Office (OE/AL). This report summarizes metrology activities that received emphasis in the second half of 1987 and provides information pertinent to the orperation of the DOE/AL system-wide Standards and Calibration Program.

9901 Management

REFER ALSO TO CITATION(S) 30157

31974 (CONF-8605117—, pp 153-155) **Undergraduate energy education.** Gholam-Nezhad, H. (Moorhead State Univ., MN (USA)). 1986. NTIS, PC A10/MF A01. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

As their society becomes more and more complex and technical, the need for specialization becomes more obvious. Particularly in the energy field where the conventional resources are being exhausted, and the relationships between production, energy use, and an acceptable environment becomes very difficult to balance. Management of energy resources requires a new breed of professionals who have a clear understanding of the energy industry and the societal needs for energy. In the years ahead many institutions will be involved in training energy economists, solar-energy specialists, energy environmentalists, and many other specialized professionals. However, the most immediate need in the energy field where technology, business, economies, and politics are becoming increasingly intertwined, is for innovative managers who have a clear understanding of the complex relationships involved. This paper discusses existing energy programs, the energy management plan at Moorhead State University, and the employment opportunities for energy managers.

31975 (IAEA-TECDOC—443, pp 181-192) **OKG operator strategy at severe accidents.** Jonsson, U. (OKG AB, Stockholm (Sweden). Technical Dept. for Safety Analysis). Dec 1987. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88702506/JAW. (CONF-8609420—).

From Technical committee meeting on experience with simulator training for emergency conditions; Vienna, Austria (15 Sep 1986).

In this paper the principle applied to develop and implement counter measures against severe accidents, taken by the OKG, is discussed. This strategy involves several areas: additional hardware installations such as a containment pressure relief system and filtered containment vent and independent containment spray system; an analysis of accident sequences; and overall accident management including emergency planning, improved education of personnel and well structured emergency operating procedures. (author). 4 figs.

31976 (INIS-mf—11151) **Modern information science serves the nuclear power complex.** (Ceskoslovenska Vedecko-technicka Spolecnost, Ceske Budejovice. Dum Techniky). 1987. 83p. (In Czech). (CONF-8705283—). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW.

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

The proceedings contains the full texts of 9 papers of which 7 belong in the INIS Scope. These papers deal with the activities and services of the Nuclear Information Centre (NIC), such as are provided to institutions operating within the Czechoslovak nuclear programme. Attention is mainly focused on services based on the INIS system and other IAEA information sources, also to analytical work which is based in the NIC branch in Ceske Budejovice. (Z.M.).

31977 (INIS-mf—11151, pp 1-4) **Prospectives of research and development of the Czechoslovak Nuclear Information Centre.** Stanik, Z. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

The work of the Nuclear Information Centre (NIC) is characterized by two main functions, namely the function of the sector information centre within the Czechoslovak nuclear programme, and Czechoslovakia's participation in INIS. The factual content of NIC activities will in the coming years be oriented to two main areas: in the field of providing information sources it is to cover all data sources by its connection to all relevant information files available at home and abroad. In compliance with the world information trend the focus of NIC activities will shift to the second area, namely to the provision of knowledge. Since 1986 it has been involved in the research project "Factual data banks and other information sources for the Czechoslovak nuclear programme". The main aim of the project is to establish data retrieval systems using microcomputer technology. In this respect NIC cooperation with the respective institutions in the GDR and in Poland is very important. (Z.M.).

31978 (INIS-mf—11151, pp 30-48) **Information in the nuclear power complex.** Kripner, V. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

The problems of information flows in open complex and extensive industrial systems, such as the nuclear power complex, are discussed. The elements of the system are as follows: nuclear power and heating plants,nuclear fuels and the fuel cycle, nuclear power

engineering, nuclear power civil engineering, and the coordination system, i.e., the nuclear safety commission. The elements of the system of the nuclear power complex are continuously undergoing development, i.e., extended reproduction and innovation in a chain of logically continuous stages one following up on another: research, planning, project, implementation/construction, commissioning. The information flows of the different stages are characterized, and briefly summed up are demands on the nuclear information centre which should focus on information concerning development and feedback of all elements in the system of the nuclear power complex arranged in the respective data retrieval bases. (Z.M.). 13 figs.

31979 (INIS-mf—11151, pp 49-57) **Usability of online data bases for the nuclear power complex.** Kakos, A. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

Information services provided to the Czechoslovak nuclear power complex belong among the main tasks of the Nuclear Information Centre (NIC) as the sector information centre for the Czechoslovak Nuclear Programme. Of online systems the NIC has direct access to INIS and AGRIS in Vienna, and works with 13 data bases in the Centre of Automated Exchange of Information in the UVTEI-UTZ data base centre in Prague and through this centre with other foreign data bases. The questions are discussed of the utility and usability of various data bases for the information service provided to the nuclear power complex. The main factors which determine the usability of a data base are: the topical orientation of the base, the type composition of the base, the access period, the quality and speed of obtaining output and the existence of follow-up services. The INIS remains the basis for information services provided by NIC. In 1986, searches were made in 9 other bases at the UVTEI-UTZ data base centre and in 50 data bases accessible via the said centre abroad. (Z.M.).

31980 (INIS-mf—11151, pp 58-62) **INIS online services.** Suk, B. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

At present 15 terminals operate in Czechoslovakia in various organizations within the framework of the domestic terminal network with online access to the INIS and AGRIS data bases at the IAEA data base centre in Vienna. The Nuclear Information Centre (NIC), as the mediating centre, has at its disposal an ADT 4300 minicomputer with a KDP C 720 disc unit which provides communication and records. The operation of terminals is for payment, prices include the costs of NIC equipment, connections to Vienna and fees for the use of the data bases and the print-outs of retrieved information. A new form of services provided by NIC should in the nearest future be microstudies, i.e., searches in INIS but also in other data bases commented on the basis of an analysis of data retrieved and found in major primary documents accessible in the NIC. Also outlined are certain problems relating to the economic aspects of services provided and the evaluation of economic benefit of information. (Z.M.).

31981 (INIS-mf—11151, pp 63-68) **Services of the Czechoslovak Nuclear Information Centre, based on IAEA information sources.** Dufkova, M. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

Information services provided by the Nuclear Information Centre (NIC) as the sector information centre for the Czechoslovak nuclear programme proceed primarily from its membership of INIS. From INIS Atomindex tapes are computer-processed SDI searches, their price for one query is 3,948 Czechoslovak crowns per year. The user can at any time put forward a request for tuning or for a change of the initially requested query formulation. A copy of SDI searches is provided for 1,200 Czechoslovak crowns per annum to other interested persons or institutions who cannot, however, influence the query formulation. Since 1979, the NIC has been processing retrospective searches by direct online access to the INIS data base. The price of these searches ranges between 1,000 and 1,500 Czechoslovak crowns. Under the same conditions the NIC also provides retrospective searches from AGRIS. Since 1986, the NIC has extended its services by providing data from the UVTEI-UTZ data base centre in Prague. Retrospective searches can since 1985 be processed directly at the workplace of those interested, this through mobile terminals. All said services are followed up by services provided by the NIC library which contains more than 215,000 microfiches with full texts of nonconventional documents incorporated in INIS. (Z.M.).

31982 (INIS-mf—11151, pp 69-77) **Role of the Czechoslovak Nuclear Information Centre as a reference centre.** Blazek, J. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

The Nuclear Information Centre (NIC) is the sector information centre for the Czechoslovak nuclear programme which comprises the peaceful uses of nuclear energy, ionizing radiation and isotopes. Briefly characterized are the different types of services provided which include search processing, librarian services, study analytical work, publishing activity, the sector inventory of research reports, searches, trip reports and translations and of late the provision of factual data. In this respect this includes the following systems: Economics of Nuclear Power Plants, and Nuclear Power Plant Indicators. The NIC also processes computer-based analyses of selected topics from a document retrieval base. For these analyses the use of the COMMODORE personal computer and foreign firm software is being envisaged. In the first stage the analyses will be made from the INIS data base. (Z.M.).

31983 (INIS-mf—11151, pp 78-83) **Analytical information work and other services of the Ceske Budejovice branch of the Nuclear Information Centre.** Zachar, L. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavou. Ustredni Informacni Stredisko pro Jaderny Program). 1987. (In Czech). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88702332/JAW. (CONF-8705283—).

From Seminar on modern information science serving the nuclear power complex; Ceska Budejovice, Czechoslovakia (6 May 1987).

The fields of activity of the Nuclear Information Centre (NIC) branch in Ceske Budejovice are characterized: they include study analytical work, processing factual information, and technical and economic propaganda. Study analytical work which is the main field of the branch has a more than 17 years' tradition in the NIC. Over the said period almost 120 studies were processed and a number are being processed now. The studies were devoted to the following problem areas: nuclear power (35), the use of ionizing radiation (15), nuclear power and heat and heating plants (13), nuclear safety (7), dosimetry (7), nuclear fuel (5), etc. A new element in the work of the NIC branch are microstudies which in 1987 accounted for almost 50% of the total work load of the branch. (Z.M.).

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 31194

31984 **(AD-A—189202/5/XAB) Design of the CONSUL programming language. Technical report.** Baldwin, D. (Rochester Univ., NY (USA). Dept. of Computer Science). Feb 1987. 29p. (TR—208). NTIS, PC A03/MF A01.

The problem of automatically exploiting parallelism in computer programs, with particular emphasis on linguistic barriers to parallelism detection is studied. Although functional languages and Prolog have many desirable characteristics in this respect, they are not entirely ideal. The author therefore offers constraint-based programming as a generalization of logic programming. By virtue of the more-flexible ways in which they allow relations to be defined, constraint languages support more-natural descriptions of potentially parallel algorithms than do existing logic or functional languages. A prototype constraint language called CONSUL is introduced, which demonstrates features felt to make constraint languages well-suited for general-purpose programming of multiprocessors. The extra expressiveness of constraint languages comes at a price, namely that satisfaction of general constraints can be much more difficult than satisfaction of predicates for a language like Prolog. Nonetheless, it is thought that effective compilers for constraint languages can be built, and some ideas on which they could be based are outlined.

31985 **(AD-A—189244/7/XAB) Computing with structured connections networks. Technical report.** Feldman, J.A.; Fanty, M.A.; Goddard, N.; Lynne, K. (Rochester Univ., NY (USA). Dept. of Computer Science). Apr 1987. 39p. (TR—213). NTIS, PC A03/MF A01.

Rapid advances both in the neurosciences and in computer science are beginning to lead to a new interest in computational models linking animal brains and behavior. In computer science, there is a large and growing body of knowledge about parallel computation and another, largely separate, science of artificial intelligence. The idea of looking directly at massively parallel realizations of intelligent activity promises to be fruitful for the study of both natural and artificial computations. Much attention has been directed towards the biological implications of this interdisciplinary effort, but there are equally important relations with computational theory, hardware and software. This article focuses on the design and use of massively parallel computational models, particularly in artificial intelligence. Much of the recent work on massively parallel computation has been carried out by physicists and examines the emergent behavior of large, unstructured collections of computing units. We are more concerned with how one can design, realize and analyze networks that embody the specific computational structures needed to solve hard problems. Adaptation and learning are treated as ways to improve structured networks, not as a replacement for analysis and design.

31986 **(AD-A—189245/4/XAB) Interface between object-oriented systems. Technical report.** Crowl, L.A. (Rochester Univ., NY (USA). Dept. of Computer Science). Apr 1987. 23p. (TR—211). NTIS, PC A03/MF A01.

The Chrysalis operating system for the Butterfly Parallel Processor presents an object-oriented programming environment based on shared memory. However, because of Chrysalis's low-level orientation and its use of type-unsafe features of the C programming language, programs using the environment are difficult to program and highly error-prone. Using C as the primary programming language for the Butterfly does not fully realize the benefit of Chrysalis's object orientation. An object-oriented programming language is natural candidate for improving the Chrysalis environment. The C ++ programming language provides a number of advantages in developing such an interface. This paper reports the successes and problems encountered in the development of Chrysalis ++, a C ++ interface to Chrysalis ++ uncovered many strengths and weakness in C ++. Some apply to C ++ in general, others apply only to its adaptation to a parallel programming environment. It is important to note that C++ is a sequential language; it is use in a parallel programming environment is therefore outside the bounds of its design.

31987 **(AD-A—189315/5/XAB) Associative-memory biological and mathematical aspects. Technical report.** Eggers, M. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 29 Dec 1987. 50p. (TR—798). NTIS, PC A03/MF A01.

A tutorial is presented encompassing both biological and mathematical aspects of associative memory for pattern processing. A systems viewpoint is adopted whereby biological associative memory is viewed as a system of adaptive filters, with the free parameters of the filter corresponding to the strengths of the biological neural connections. Certainly such viewpoint is not intended to accurately depict the true mechanisms underlying the extraordinary capabilities of biological associative memory-fast pattern recognition and apparently infinite memory capacity. For such mechanisms will unlikely be discovered in the absence of tools allowing the observance of collective behavior over systems of neurons. However, the viewpoint does serve to integrate both mathematics and biology on a general level. Of most significance is perhaps the systematic treatment of mathematical associative memory. In the adaptive filter framework, associative memory is described and compared to traditional statistical techniques. Also, new insight into the generalization capability of associative memory is expressed. Conditions are presented to ensure both correct memory recall and significant generalization.

31988 **(AD-A—189466/6/XAB) Northeast Artificial Intelligence Consortium (NAIC) administrative matters and ancillary functions. Volume 1. Interim report, December 1984-December 1985.** Cotellessa, R.F.; Bray, E. (Syracuse Univ., NY (USA)). Jul 1987. 50p. NTIS, PC A03/MF A01.

The Northeast Artificial Intelligence Consortium (NAIC) was created by the USAF Electronic Systems Command, Rome Air Development Center, and the Office of Scientific Research. Its purpose is to conduct pertinent research in artificial intelligence, to encourage expansion in the number of faculty members and graduating students in this field, to make graduate educational programs available in an area centered in Rome, N.Y., and the expand university facilities to conduct appropriate research. The purpose of this report is to describe progress that has been made in the first year of the existence of the NAIC in developing and performing activities ancillary to the technical research tasks being carried out at NAIC member universities.

31989 **(AD-A—189533/3/XAB) Compilation and code generation for multiprocessor computers.** Hand, S.; Mauney, J. (North Carolina State Univ., Raleigh (USA)). 8 Apr 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Proceedings of IEEE SOUTHEASTCON '87, Vol 1, 102-105(5-8 Apr 1987).

A compiler for multiprocessor computers is described. In it, a C language source program is converted to parallel operation. Steps in compilation include dependency analysis, task partitioning, task allocation, and code generation. This scheme uses an intermediate representation that allows compilation of multiple high-level source languages, such as FORTRAN and Ada. It also uses a retargetable code generator, allowing code generation onto multiple target machines.

31990 **(AD-A—189557/2/XAB) Retinotopic mapping of the human visual system with magnetoencephalography. Master's thesis.** Dowler, M.G. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 72p. (AFIT/GEP/ENP—87D-6). NTIS, PC A04/MF A01.

A retinotopic mapping was verified using magnetoencephalography as the means to observe brain activity in one human subject. The stimulus consisted of 12 sectors of a hemicircle, 6 foveal and 6 peripheral out to about 17 degrees visual field angle. The sectors flashed individually for 63 milliseconds with an inter-stimulus-interval between .8 and 1.8 seconds. The recording computer was synchronized to the stimulus and recorded for .5 seconds after onset of stimulus. Thirty averages were taken for each stimulus section, for each of about 45 grid points on the scalp. The sectors were localized to distinct points in the primary visual cortex (area 17). The results did not verify the cruciform model of retinotopic

mapping nor the theory that more visually eccentric stimuli produce deeper responses. The data seem to suggest and different type of mapping for foveal stimuli than peripheral, but this could also be due to the fold structure of the primary visual cortex.

31991 **(AD-A—189569/7/XAB) Why we can't program multiprocessors the way we're trying to do it now. Technical report.** Baldwin, D. (Rochester Univ., NY (USA). Dept. of Computer Science). Aug 1987. 36p. (TR—224). NTIS, PC A03/MF A01.

Parallel computation is an area in which software technology lags considerably behind hardware technology. The need for parallel computing in a number of applications (e.g., scientific computing, machine vision, artificial intelligence) is unquestioned, and computers with hundreds of processors are now readily available (for instance, the Butterfly or the many derivatives of the Cosmic Cube). However, these machines are programmed in essentially the same way as existing sequential machines. The best-available parallel programming languages are variants of standard sequential languages, with extensions to let the programmer explicitly divide a program into tasks and pass information between those tasks. Although designers of these languages claim that they are no harder to use than conventional sequential ones, programmers still face the problem of figuring out how to partition their application into tasks in addition to the usual problem of translating it into a program. An appealing alternative is to leave partitioning of programs to compilers. By hiding partitioning problems from programmers, this approach should make multiprocessor computers easier to program than they are now. Unfortunately efforts to develop parallelizing compilers have so far been rather unsuccessful.

31992 **(AD-A—189573/9/XAB) Simulation study of a parallel processor with unbalanced loads. Master's thesis.** Moore, T.S. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 115p. (AFIT/GCS/ENG—87D-20). NTIS, PC A06/MF A01.

Original contains color plates: All DTIC and NTIS reproductions will be in black and white.

The purpose of this thesis was twofold: to estimate the impact of unbalanced computational loads on a parallel-processing architecture via Monte Carlo simulation; and second to investigate the impact of representing the dynamics of the parallel-processing problem via animated simulation. It is constrained to the hypercube architecture in which each node is connected in a predetermined topology and allowed to communicate to other nodes through calls to the operating system. Routing of messages through the network is fixed and specified within the operating system. Message-transmission preempts nodal processing causing internodal communications to complicate the concurrent operation of the network. Two independent variables are defined: 1) the degree of imbalance characterizes the nature or severity of the load imbalance, and 2) the degree of locality characterizes the node loadings with respect to node locations across the cube. A SLAM II simulation model of a generic 16 node hypercube was constructed in which each node processes a predetermined number of computational tasks and, following each task, sends a message to a single randomly chosen receiver node. An experiment was designed in which the independent variables, degree of imbalance and degree of locality were varied across two computation-to-IO ratios to determine their separate and interactive effects on the dependent variable, job speedup. ANOVA and regression techniques were used to estimate the relationship between load imbalance, locality, computation-to-IO ratio, and their interactions to job speedup. Results show that load imbalance severely impacts a parallel-processor's performance.

31993 **(AD-A—189767/7/XAB) Parallel memory addressing using coincident optical pulses.** Chirulli, D.; Melhem, R.; Levitan, S. (Pittsburgh Univ., PA (USA). Dept. of Computer Science). Dec 1987. 21p. NTIS, PC A03/MF A01.

The common-computer-bus, shared-memory, multiprocessors are the most widely used parallel-processing architectures. Unfortunately, such systems suffer from a memory/bus bandwidth limitation problem. For the designer of a hybrid optical/electronic supercomputer, an immediate temptation is to replace the shared electronic bus with an optical analog of higher bandwidth. To make that replacement is only a partial solution. The true bottleneck in such systems is in the address decoding circuits of shared memory units. In this paper we propose a new memory structure which provides for parallel access in a multiprocessor environment. The proposed system has two advantages. First, it distributes the address decoding circuitry to each of the requesting units on a common bus, thus eliminating the bottleneck of centralized decoding of encoded memory addresses. Second, it allows for parallel fetches of memory data with a level of parallelism limited only by the ratios of optical to electronic bus bandwidths and the dimensionality of the memory array.

31994 **(AD-A—189772/7/XAB) Applications of optical computing to problems with symbolic computations. Quarterly report No. 7, 1 August 1986-1 November 1987.** Kushner, B.G. (BDM Corp., Vienna, VA (USA)). 31 Oct 1987. 5p. NTIS, PC A02/MF A01.

This report experimentally demonstrates digital all-optical Compare and Energy circuits based on original designs. The circuits uses ZnS bistable optical devices in novel operational modes such as bidirectional and latching logic. These modes are central to the low complexity of the implementation. In addition, the experimental demonstration utilizes polarization multiplexing and filtering to reduce crosstalk, losses, and feedback in the optical system. The capabilities of optical-interconnection networks are generally useful in parallel processing and specifically useful in sorting.

31995 **(AD-A—189773/5/XAB) Northeast artificial intelligence consortium (NAIC) review of technical tasks. Volume 2, part 1. Interim report, December 1984-December 1985.** Allen, J.F.; Berra, P.B.; Biles, J.A.; Bowen, K.A.; Conry, S.E. (Northeast Artificial Intelligence Consortium, Syracuse, NY (USA)). Jul 1987. 464p. NTIS, PC A20/MF A01.

See also Volume 2, Part 2, AD-A189 774.

The Northeast Artificial Intelligence Consortium (NAIC) was created by the Air Force Systems Command, Rome Air Developmental Center, and the Office of Scientific Research. Its purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made in the first year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system.

31996 **(AD-A—189774/3/XAB) Northeast Artificial Intelligence Consortium (NAIC) review of technical tasks. Volume 2, part 2. Interim report, December 1984-December 1985.** Allen, J.F.; Berra, P.B.; Biles, J.A.; Bowen, K.A.; Conry, S.E. (Northeast Artificial Intelligence Consortium, Syracuse, NY (USA)). Jul 1987. 473p. NTIS, PC A20/MF A01.

See also Volume 2, Part 1, AD-A189 773.

The Northeast Artificial Intelligence Consortium (NAIC) was created by the Air Force Systems Command, Rome Air Developmental Center, and the Office of Scientific Research. Its purpose is to conduct pertinent research in artificial intelligence and to perform activities ancillary to this research. This report describes progress that has been made in the first year of the existence of the NAIC on the technical research tasks undertaken at the member universities. The topics covered are: versatile expert system for equipment maintenance, distributed AI for communications system control, automatic photo interpretation, time-oriented problem solving, speech understanding systems, knowledge base maintenance, hardware architectures for very large systems, knowledge-based reasoning and planning, and a knowledge acquisition, assistance, and explanation system.

31997 (AD-A—189849/3/XAB) Implementation of a distributed adaptive routing algorithm on the intel IPSC (Intel Personal Supercomputer). Master's thesis. Farinelli, T.C. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1987. 103p. (AFIT/GCS/ENG—87D-11). NTIS, PC A06/MF A01.

The purpose of this study was to examine the use of distributed adaptive routing algorithms on concurrent-class computers. The implemented routing algorithm allowed each node to select the next node based on two criteria: the fewest number of hops; and the smallest delay time. This study was limited to the comparison of a distributed adaptive routing algorithm, implemented at the applications layer, with the current static routing and with a simulation of the current routing implemented at the applications layer. The comparison with the simulated current static routing provides a measure of the possible performance gain had the adaptive routing algorithm been implemented at the network layer. Each of three configuration was comprised of four processes: a Host Process, a Routing Process, a Ring Control Process, and a Network Loading Process. The Host Process controlled the loading of the processes onto the IPSC, the Routing Process controlled the message routing, the Ring Control Process provided the baseline message passing, while the Network Loading Process provided communications congestion on selected links. The metric used to compare the Routing Process performance was the average delay time for passing a message around the ring.

31998 (ANL—88-2) Reference manual for the environmental theorem prover: An incarnation of AURA [AUtomated Reasoning Assistant]. Smith, B.T. (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 81p.

This document provides a complete specification of the input language for the environmental theorem prover. This language is essentially the same input language used by any of the programs designated by AURA, an automated reasoning program developed at Argonne National Laboratory. The intended audience is the user who is already familiar with the concepts and terms associated with resolution-based theorem provers.

31999 (ANL—88-3) Portable implementation of a generic exponential function in Ada. Tang, Ping Tak Peter. (Argonne National Lab., IL (USA)). Feb 1988. Contract W-31109-ENG-38. 33p.

By presenting a provably accurate implementatio of the exponential function, we illustrate that an accurate and portable elementary-function library can be implemented in Ada. 7 refs.

32000 (ANL/MCS-TM—109) Vectorizing compilers: A test suite and results. Callahan, D.; Dongarra, J.; Levine, D. (Rice Univ., Houston, TX (USA). Dept. of Computer Science; Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Mar 1988. Contract W-31109-ENG-38. 35p.

This report describes a collection of 100 Fortran loops used to test the effectiveness of anautomatic vectorizing compiler. We present the results of compiling these loops using commercially available, vectorizing Fortran compilers on a variety of supercomputers, mini-supercomputers, and mainframes.

32001 (ANL/TM—336-Rev.1) Guide to computing at ANL. Bennon, P.S.; Hinds, A.R.; Slocum, R.E.; Caruthers, C.M.; Bragg, R.W. (eds.). (Argonne National Lab., IL (USA)). Mar 1988. Contract W-31109-ENG-38. 102p.

This paper's primary purpose is to acquaint the user with various computers, computing systems, and computing procedures at Argonne National Laboratory. It is also used to assist the user in selecting the computer, system, network and software with which they can do their work most efficiently. 2 figs., 11 tabs.

32002 (BNL—40990) Effective communication between a microVAX and a specialized high-speed subprocessor. Sweely, H.D.; Wang, Hong. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 27p.

Designing a software system that provides effective communication between two processors requires consideration of many factors. For this project, these factors are divided into two fundamental groups: system requirements; and experimental requirements. This design note describes each of these areas, first in general, then in system specific terms. The general description intends to illustrate what is traditionally required to build a system of this type. This is useful during both planning and engineering states. The system specific description provides users of the FASTRUN system with a technical depiction of the communication mechaisms and protocol.

32003 (BNL—41113) Two domain decomposition techniques for Stokes problems. Pasciak, J.E. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 11p.

I will develop two domain decomposition techniques for Stokes problems in this talk. The first uses a reformulation of the saddle point system and reduces the derivation of domain decomposition algorithms for Stokes to the definition of domain decomposition preconditioners for second order problems. The second applies domain decomposition directly to Stokes and gives rise to a saddle point system for the velocity nodes on the subdomain boundaries and the mean values of the pressure on the subdomains. This system is solved iteatively.

32004 (CONF-870860—1) Similarity solutions of nonlinear partial differential equations invariant to a family of affine groups. Dresner, L. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 13p.

From 6. international conference on mathematical modelling; Saint Louis, MO, USA (4 Aug 1987).

Problems of technological interest can very often be described by partial differential equations (PDEs) with one dependent and two independent variables (call them c, z, and t, respectively). Many such PDEs are invariant to one-parameter families of one-parameter affine groups. Similarity solutions are solutions of the PDE that are invariant to one group of the family. The great utility of similarity solutions is that they may be calculated by solving an ODE rather than a PDE and are thus much more easily accessible than other solutions. The form of the principal ODE depends, of course, on the form of the PDE, but it can be proved quite generally that the principal ODE is itself invarient to the one-parameter affine group or associated group. because of the invariance of the principal ODE to the associated group, the dependence on the boundary and initial conditions of certain special values of the function y(x), e.g., y(O), y(∞), y(O), ets., may be predicted a priori without solving the principal ODE. The nonlinear PDE of heat transport in superfluid He-II, is used as an illustration of these ideas in this review.

32005 (CONF-880117—4) Multi-sensor integration on the NCUBE hypercube computer. Glover, C.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p.

From 3. conference on hypercube concurrent computers and applications; Pasadena, CA, USA (19 Jan 1988).

This paper presents the quantitative performance results obtained from converting a large sequential Multi-Sensor Integration (MSI) program into aconcurrent form, and executing the program on an NCUBE hypercube computer for several test case scenarios. Each sensor track was assigned to a different node of the hypercube where computationally intensive calculations were performed. A 4-mode hypercube was found to be the optimal size for the test case scenario discussed here, where speed-up factors of 1.5 to 1.7 were obtained. A completely concurrent MSI algorithm is also presented. 1 ref., 9 figs.

32006 (CONF-880540—1) Network architecture for OPS5. Butler, P.L.; Allen, J.D.; Bouldin, D.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 14p.

From 15. annual international symposium on computer architecture; No City Given, HI, USA (30 May 1988).

The design and implementation of a non-Rete based architecture which captures some of the inherent parallelism in the OPS5 expert system language are discussed. A central feature of the architecture is a network bus over which a single host proces-

sor broadcasts messages to a set of parallel rule processors. This transmit-only bus is implented by a memory-mapped shceme which permits the rule processors to be decoded in parallel. All OPS5 rule matching processes and most of those associated with conflict resolution are executed by the parallel rule processors. The host performs the tasks associated with the firing of a selected rule. Performance data are presented for the prototype system which comprise a hot processor and 64 parallel rule processors, each embodying a Motorola MC68000 microprocessor and 512 kbytes of unshared memory. 6 refs., 4 figs.

32007 **(CONF-880551—1) A mixed-modem solution for sensitive data segregation on a broadband network.** Crutcher, R.I.; Ewing, P.D. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 12p.

From DOE computer security group conference; Kansas City, MO, USA (3 May 1988).

Data isolation is required in broadband networks to prevent unauthorized access to the sensitive data of other users. Isolation can be obtained by using equipment from different manufacturers to introduce incompatibility between nonassociated users. This paper develops the basis for isolation and postulates that four layers of ioslation will exist when the proper equipment is chosen. An experimental broadband local area network (LAN) was constructed to verify isolation. This independent test system allowed variations to network operating conditions without causing interference to normal broadband operations. The measured results indicate that a broadband LAN can transmit data of varying sensitivity levels without compromising data security. When combined with the proper administrative restrictions, the mixed-modem technique provides a cost-effective method of sharing a broadband network while maintaining isolation of data having different sensitivities. 6 refs., 3 figs.

32008 **(CONF-880601—2) Multidimensional nodal transport methods for multiple-instruction multiple-data distributed memory machines.** Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 7p. NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88004732/JAW.

From American Nuclear Society annual meeting; San Diego, CA, USA (12 Jun 1988).

As computer hardware technology approaches the physical limits (on size and speed) of the electronic components of computer systems, it has become evident in recent years that any significant improvements in the performance of future systems must be rooted in advanced architectures. Efforts in this direction have resulted in numerous ideas and designs for vector and parallel processors. Amo~ the many problems that have been implemented on the new systems is the neutron and photon transport equation. Monte Carlo type methods have been implemented on Shared Memory (SM) and Distributed Memory (DM) Multiple-Instruction Multiple-Data (MIMD) machines. On the other hand, implementation of discrete-ordinates type methods on SM, MIMD systems has been considered for general codes, as well as special one-dimensional, multigroup codes. More recently, implementation of the latter code on the hypercube, and the comparison between two chaotic and one ordered iterative schemes have been reported. In this Summary we present the implementation of the zeroth and first-order two-dimensional nodal transport methods on the hypercube. Our objective is to study the effect of the various parameters in a simple test problem on the speedup and efficiency in order to determine the cases most suitable for solving on a DM machine such as the hypercube. 9 refs., 1 fig.

32009 **(CONF-8706130—5) Nonlinear neural network for deterministic scheduling.** Gulati, S.; Iyengar, S.S.; Toomarian, N.; Protopopescu, V.; Barhen, J. (Louisiana State Univ., Baton Rouge (USA). Dept. of Computer Science; Oak Ridge National Lab., TN (USA). Engineering Physics and Mathematics Div.). 1988. Contract AC05-84OR21400. 8p.

From 1. IEEE international conference on neural networks; San Diego, CA, USA (21 Jun 1987).

This paper addresses the NP-complete, deterministic scheduling problem for a single server system. Given a set of n tasks along with the precedence-constraints among them, their timing requirements, setup costs and their completion deadlines, a neuromorphic model is used to construct a non-preemptive optimal processing schedule such that the total completion time, total tardiness and the number of tardy jobs is minimized. This model exhibits faster convergence than techniques based on gradient projection methods.

32010 **(DP-MS—87-163) Idea processing for creativity and management.** Miller, P.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 5p. (CONF-880528—4).

From 35. annual international technical communication conference; Philadelphia, PA, USA (10 May 1988).

Tips and case histories on computer use for idea and outline processing: Productivity software to solve problems of idea hierarchy, transitions, and developments is matched to solutions for communicators. One case is text that ranges from methods and procedures to histories and legal definitions of classification for the US Department of Energy. Applications of value to writers, editors, and managers are for research; calendars; creativity; prioritization; idea discovery and manipulation; file and time management; and contents, indexes, and glossaries. 6 refs., 7 figs.

32011 **(E—11-87-367) Simple statistical multivariate approach to weak signals extraction.** Slowinski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 26 May 1987. 11p. (CONF-8706283—1).

From 2. international tampere conference in statistics; No City Given, Finland (1 Jun 1987).

In the paper two examples of application of the multivariate data analysis are described. These examples are typical enough for experimental high energy physics and illustrate an advantage of even simple multivariate approach to analyzing numerical results. Whenever possible, over the univariate one. It is also pointed out that such approach may be constructed as a set of simple fast procedures suitable for using when an experimental device operate online with a computer.

32012 **(LA-UR—87-3129) The -mdoc macro package: A software tool to support computer documentation standards.** Sanders, C.E. (Los Alamos National Lab., NM (USA)). 16 Sep 1987. Contract W-7405-ENG-36. 13p. (CONF-880528—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88000500/JAW.

From 35. annual international technical communication conference; Philadelphia, PA, USA (10 May 1988).

At Los Alamos National Laboratory a small staff of writers and word processors in the Computer Documentation Group is responsible for producing computer documentation for the over 8000 users of the Laboratory's computer network. The -mdoc macro package was developed as a software tool to support that effort. The -mdoc macro package is used with the NROFF/TROFF document preparation system on the UNIX operating system. The -mdoc macro package incorporates the standards for computer documentation at Los Alamos that were established by the writers. Use of the -mdoc macro package has freed the staff of programming format details, allowing writers to concentrate on content of documents and word processors to produce documents in a timely manner. It is an easy-to-use software tool that adapts to changing skills, needs, and technology. 5 refs.

32013 **(LA-UR—88-978) The MAFIA approach to solving Maxwell's equations in three dimensions.** Cooper, R.K.; Browman, M.J.; Weiland, T. (Los Alamos National Lab., NM (USA); Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). 1988. Contract W-7405-ENG-36. 11p. (CONF-880370—1).

From 4. annual review of progress in applied computational electromagnetics; Monterey, CA, USA (22 Mar 1988).

The acronym MAFIA stands for the solution of Maxwell's equations by the Finite Integration Algorithm and is the name give to a set of codes intended for use in the computer-aided design of three-dimensional magnets, rf structures, and structures in which wake-field effects are important. This paper gives a brief description of the algorithms employed in both the time- and the frequen-

cy- domain solvers of the MAFIA collection of codes. Examples of typical accelerator calculations will be presented. 9 refs., 6 figs.

32014 **(LBL—24808) RAGS [Realtime Acquisition and Graphics System]: An off-the-shelf hardware and system software small data acquisition computer.** Leres, R.G. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 5p.

A family of small, functionaly comprehensive CAMAC based data acquisition systems has been developed to support experimenters whose requirements are not always compatible with available acquisition systems. Distinguishing features of these systems are their commercially built computer and CAMAC hardware, and the Fortran-77 programming language environment they provide to the user. These RAGS (Realtime Acquisition and Graphics System) units are most appropriate when the user is not able to support the dvelopment of original or 'one of a kind' hardware or software for data acquisition.

32015 **(N—88-20014) Intelligent allocation algorithm for parallel processing.** Carroll, C.C.; Homaifar, A.; Ananthram, K.G. (Alabama Univ., University (USA)). Jan 1988. 88p. (NASA-CR—182648; NAS—1.26:182648; BER—416-17). NTIS, PC A05/MF A01.

The problem of allocating nodes of a program graph to processors in a parallel processing architecture is considered. The algorithm is based on critical path analysis, some allocation heuristics, and the execution granularity of nodes in a program graph. These factors, and the structure of interprocessor communication network, influence the allocation. To achieve realistic estimations of the executive durations of allocations, the algorithm considers the fact that nodes in a program graph have to communicate through varying numbers of tokens. Coarse and fine granularities have been implemented, with interprocessor token-communication duration, varying from zero up to values comparable to the execution durations of individual nodes. The effect on allocation of communication network structures is demonstrated by performing allocations for crossbar (non-blocking) and star (blocking) networks. The algorithm assumes the availability of as many processors as it needs for the optimal allocation of any program graph. Hence, the focus of allocation has been on varying token-communication durations rather than varying the number of processors. The algorithm always utilizes as many processors as necessary for the optimal allocation of any program graph, depending upon granularity and characteristics of the interprocessor communication network.

32016 **(N—88-20015) Efficient parallel architecture for highly coupled real-time linear system applications.** Carroll, C.C.; Homaifar, A.; Barua, S. (Alabama Univ., University (USA)). Jan 1988. 95p. (NASA-CR—182649; NAS—1.26:182649; BER—419-17). NTIS, PC A05/MF A01.

A systematic procedure is developed for exploiting the parallel constructs of computation in a highly coupled, linear system application. An overall top-down design approach is adopted. Differential equations governing the application under consideration are partitioned into subtasks on the basis of a data flow analysis. The interconnected task units constitute a task graph which has to be computed in every update interval. Multiprocessing concepts utilizing parallel integration algorithms are then applied for efficient task graph execution. A simple scheduling routine is developed to handle task allocation while in the multiprocessor mode. Results of simulation and scheduling are compared on the basis of standard performance indices. Processor timing diagrams are developed on the basis of program output accruing to an optimal set of processors. Basic architectural attributes for implementing the system are discussed together with suggestions for processing element design. Emphasis is placed on flexible architectures capable of accommodating widely varying application specifics.

32017 **(N—88-20016) Computer architecture for efficient algorithmic executions in real-time systems: new technology for avionics systems and advanced space vehicles.** Carroll, C.C.; Youngblood, J.N.; Saha, A. (Alabama Univ., University (USA)). Dec 1987. 82p. (NASA-CR—182650; NAS—1.26:182650; BER—410-17). NTIS, PC A05/MF A01.

Improvements and advances in the development of computer architecture now provide innovative technology for the recasting of traditional sequential solutions into high-performance, low-cost, parallel system to increase system performance. Research conducted in development of specialized computer architecture for the algorithmic execution of an avionics system, guidance and control problem in real time is described. A comprehensive treatment of both the hardware and software structures of a customized computer which performs real-time computation of guidance commands with updated estimates of target motion and time-to-go is presented. An optimal, real-time allocation algorithm was developed which maps the algorithmic tasks onto the processing elements. This allocation is based on the critical path analysis. The final stage is the design and development of the hardware structures suitable for the efficient execution of the allocated task graph. The processing element is designed for rapid execution of the allocated tasks. Fault tolerance is a key feature of the overall architecture. Parallel numerical integration techniques, tasks definitions, and allocation algorithms are discussed. The parallel implementation is analytically verified and the experimental reaults are presented. The design of the data-driven computer architecture, customized for the execution of the particular algorithm, is discussed.

32018 **(ORNL/DSRD/TM—16) Evaluation of VT100 emulator for Pacific Missile Test Center.** Phillips, J.T.; Wood, W.B. (Oak Ridge National Lab., TN (USA). Data Systems Research and Development Program). Mar 1988. Contract AC05-84OR21400. 29p.

At the request of the Pacific Missile Test Center at Point Mugu, California, a comparison testing of VT100 terminal emulation capabilities of two microcomputers and software packages was performed. The results ofthe tests indicate that emulation of the communications interface is close to that of the original VT100 terminal. However, keyboard differences between the IBM PC clone microcomputers tested and the original VT100 terminal keyboard layout result in a serious lack of user friendliness. In addition, specific capabilities or functions of the original VT100 terminals such as 132 column screens, different send/receive baud rates, and certain video characteristics are not exactly reproducible. An overview of specific added capabilities of the emulators is also given.

32019 **(ORNL/TM—10177) An evaluation of Ethernet connectivity via broadband bridge.** Hayes, R.W.; Farmer, J.T. Jr. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 33p.

This report presents the results of an evaluation project to examine the performance characteristics of the Bridge Communications, Inc., Ethernet-Broadband bridge. This bridge is under consideration for use on the Oak Ridge National Laboratory/interplant broadband network to provide interconnectivity among various local Ethernet segments installed throughout the facility. Evaluation of the bridge is based on the needs of plant-wide communication via broadband technology. Tests of performance and reliability demonstrated that the IB/I Bridge offers adequate throughput for this application with excellent reliability and durability. 4 refs., 9 figs., 2 tabs.

32020 **(ORNL/TM—10691) QR factorization of a dense matrix on a hypercube multiprocessor.** Chu, E.; George, A. (Waterloo Univ., Ontario (Canada). Dept. of Computer Science; Oak Ridge National Lab., TN (USA)). 10 Feb 1988. Contract AC05-84OR21400. 52p.

In this article we describe a new algorithm for computing the QR factorization of a rectangular matrix on a hypercube multiprocessor. The scheme involves the embedding of a two-dimensional grid in the hypercube network. We employ a global communication scheme which uses redundant computation to maintain data proximity, and the mapping strategy is such that for a fixed number of processors the processor idle time is small and either constant or grows linearly with the dimension of the matrix. A complexity analysis tells us what the aspect ratio of the embedded grid should be in terms of the shape of the matrix and the relative speeds of communication and computation. Numerical experiments performed on an Intel Hypercube multiprocessor support the theoretical results. 21 refs., 20 tabs.

32021 **(PB—88-862339/XAB) Petri Nets for parallel processing and concurrent systems. January 1975-April 1988 (Citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-April 1988.** (National Technical Information Service, Springfield, VA (USA)). Apr 1988. 106p. NTIS PC N01/MF N01.

Supersedes PB—87-857769.

This bibliography contains citations concerning principles and properties of Petri Nets and their uses and interpretation in modeling and simulating a wide variety of concurrent systems as well as their implementation in parallel processing. Control, verification, and validation concepts by Petri Nets are also considered. (This updated bibliography contains 220 citations, 50 of which are new entries to the previous edition.)

32022 **(SAND—86-2855) MINIAC, A small embedded computer.** Davidson, G.S.; Grafe, V.G. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 17p.

The new generation of processor chips and denser memories, all operating at higher clock rates, has made possible a new class of computer. These small, single processor computers are suitable for applications that until recently required several slower processors. The MINIAC computer, developed by the electronic Subsystems Department at Sandia National Laboratories, exploits these new components and takes further advantage of new fabrication and packaging techniques to produce a miniature computer. The result is a 3.1 MIPS machine in approximately 11 cubic inches that is less expensive to produce than earlier multiprocessors with equivalent performance. Significant for embedded applications, its power consumption is under 5 watts when active. During inactive, standby operation, only 4 milliwatts are required to maintain the contents of the memory chips. As a result, an embedded system with MINIAC only needs small batteries, which further reduces the volume and weight resources allocated to computer functions. 11 refs., 8 figs.

32023 **(SAND—87-1088) A high speed serial link interface for SANDAC-V.** Grafe, V.G.; Davidson, G.S.; Wilde, M.G. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 23p.

A need has been identified for high speed communications between embedded computers and their associated gateway computers. To this end, a high speed serial link has been developed in Sandia National Laboratories' Electronics Subsystems Department for interfacing the SANDAC-V embedded computer to an IBM-PC gateway. The resulting 20 Mbit/second serial link is shown to be suitable for direct interfaces to sensors, actuators, and other computers in the embedded environment. Characteristics of this link and previous methods are presented. Complete schematics and directions for use are included as appendices. 10 refs., 4 figs.

32024 **(SAND—87-2552C) Considerations involved in the display of finite element results using animation.** Gwinn, K.W.; Koteras, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 6p. (CONF-880661—4).

From ASME pressure vessel and piping conference; Pittsburgh, PA, USA (19 Jun 1988).

The presentation of results from complicated finite element analyses is as important and sometimes as difficult as the analysis itself. As the analyses become more systematically and physically complicated the presentation of vast quantities of data has become the limiting factor for understanding the results. This is due to limitations in the available display media with the additional difficulty of data transmission to the media itself. The use of thigh-end graphics devices is one useful means of interpreting the complex results from numerical analyses. Generation of animation sequences is another useful tool for examining results. In the past, movie film has served as the basis for generation of animation sequences. Processing and editing of film has proved to be a cumbersome process. Video is an alternative which eliminates some of the problems of film. However, computer animation and video must be carefully integrated if the high quality of the computer animation is to be preserved. This paper will discuss the various considerations which must be made when video is used as a basis for generation of animation sequences for numerical analyses. 5 refs., 3 figs.

32025 **(SAND—87-2862C) Engineering drawings and changes: Storing and controlling by the tens of terrabytes.** Stauffer, J.D. (Sandia National Labs., Albuquerque, NM (USA)). [1988]. Contract AC04-76DP00789. 8p. (CONF-880579—1).

From 10. annual ideas in science and electronics exposition; Albuquerque, NM, USA (10 May 1988).

This talk presents an overview of the equipment and methods being installed at Sandia National Laboratories, Albuquerque, to manage information in a digital form. To store and access this data, the Design Information Management Department is planning a network of Write-Once-Read-Many (WORM) optical disk storage, image management workstations in centralized locations and across the laboratories, compression and conversion software, and access and database software interfaces to traditional engineering data processing. Computer-aided design data will be transmitted directly to the centralized storage area, and paper and microfilm documents will be entered through scanning, which will allow drawing restoration, modification, and general editing.

32026 **(SAND—88-0243) A description of the reference frames and the coordinate transformations used in AMEER [Aero-Mechanical Equations Evaluations Routines].** LaFarge, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 23 Mar 1988. Contract AC04-76DP00789. 75p.

A guide to the use of AMEER (Aero-Mechanical Equations Evaluations Routines) was previously published. This report is intended to supplement the previous user's manual by analyzing in detail the reference frames in AMEER and their relationships. The coordinate transformations used in the initialization process and in the computational phase for both the six degree of freedom (6-DOF) and the point mass (PM) trajectory options are derived. Additionally, the PM equations of motion are derived. 7 refs., 19 figs.

32027 **(SAND—88-0372C) The scaled-sized model: A revision of Amdahl's law.** Gustafson, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 11p. (CONF-880567—4).

From 3. international conference on supercomputing; Boston, MA, USA (15 May 1988).

The conventional argument, generally attributed to Amdahl, is that vector and parallel architectures should not be carried to extremes because the scalar or serial portion of the code will eventually dominate. Since pipeline stages and extra processors obviously add hardware cost, a corollary to this argument is that the most cost-effective computer is one based on uniprocessor, scalar principles. For architectures that are both parallel and vector, the argument is compounded, making it appear that near-optimal performance on such architectures is a near-impossibility. We present an argument based on the assumption that program execution time, not problem size, is constant for various amounts of vectorization and parallelism. This has a dramatic effect on Amdahl's argument, revealing that one can be much more optimistic about achieving high speedups on massively-parallel and highly-vectorized machines. The revised argument is supported by recent results of over 1000 times speedup on 1024 processors on several practical scientific applications. 3 refs., 6 figs.

32028 **(SAND—88-0605) GRAPHICS MANAGER (GFXMGR): An interactive graphics software program for the Advanced Electronics Design (AED) graphics controller, Model 767.** Faculjak, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 42p.

Graphics Manager (GFXMGR) is menu-driven, user-friendly software designed to interactively create, edit, and delete graphics displays on the Advanced Electronics Design (AED) graphics controller, Model 767. The software runs on the VAX family of computers and has been used successfully in security applications to create and change site layouts (maps) of specific facilities. GFXMGR greatly benefits graphics development by minimizing display-development time, reducing tedium on the part of the user, and improving system performance. It is anticipated that GFXMGR can be used to create graphics displays for many types of applications. 8 figs., 2 tabs.

32029 **(SAND—88-0609) Logic and fault simulation on the Mach1000 hardware accelerator.** Hofstadler, P. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1988. Contract AC04-76DP00789. 196p.

This document describes an interface between Mentor Graphics brand workstations and the Mach1000 simulation accelerator from Silicon Solutions (Zycad) Corp. It discusses logic and fault simulation concepts, system administration, dimulation models, hierarchical fault reporting, and hierarchical fault analysis. The tools that are presented perform simulations (MX), report fault simulation results hierarchically (Fault←Analyze), and schedule jobs to share the Mach1000 (SSD). In addition, a method of hierarchical fault analysis is developed that allows the use to determine whether a fault is undetectable or at best possibly detectable (divergent). The tools that implement the hierarchical fault analysis method are also presented. Numerous example problems are worked throughout to clarify and demonstrate the concepts that are being discussed.

32030 **(SAND—88-0622C) A multiprocessor data flow accelerator module.** Davidson, G.S.;Pierce, P.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880577—2). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE88007587/JAW.

From Military computing conference; Anaheim, CA, USA (3 May 1988).

Real-time controllers often need to minimize the latency between the arrival of a stimulus and the delivery of a control signal. Using multiprocessors to compute the control algorithm is appealing for these applications, but problem decomposition and load leveling are not straightforward. The data flow model of computation offers a solution which can be implemented for shared memory, parallel processors by the addition of a single circuit board. A typical parallel processor, the data flow model, and several versions of the Data flow Accelerator Module (DFAM) are presented together with some preliminary results. 15 refs., 12 figs.

32031 **(UCID—21348) Graphical Multiprocessing Analysis Tool (GMAT).** Seager, M.K.; Campbell, S.; Sikora, S.; Strout, R.; Zosel, M. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 47p. (ISCR—87-2).

The design and debugging of parallel programs is a difficult task due to the complex synchronization and data scoping issues involed. to aid the programmer in paralle code dvelopment we have developed two methodologies for the graphical display of execution of parallel codes. The Graphical Multiprocessing Analysis Tools (GMAT) consist of stategraph, which represents an inheritance tree of task states, and timeline, which represens task as flowing sequence of events. Information about the code can be displayed as the application runs (dynamic mode) or played back with time under user control (static mode). This document discusses the design and user interface issues involved in developing the parallel application display GMAT family. Also, we present an introductory user's guide for both tools. 4 figs.

32032 **(UCID—21350) SEGMERGE: A scanline visible surface algorithm with adaptive span selection and inexpensive antialiasing.** Balch, T. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 11p.

Spanning scanline algorithms are efficient because they take advantage of scanline and span coherence. An entire horizontal "span" can be declared visible at once, thus avoiding comparisons at each pixel. It is important that the number of spans be minimized because depth comparisons are made at each one. This paper presents two new techniques for scanline visible surface rendering: first, a span selection method which minimizes the number of spans and discards invisible segments; second, an inexpensive antialiasing method. It will be shown that subprixel sampling for antialiasing requiring N^2 times more work for point sampling algorithms can be done with only N times more work for spanning scanline algorithms. 15 refs., 4 figs.

32033 **(UCID—21357) SLATEC/LDOC [Sandia, Los Alamos, Air Force Weapons Laboratory Technical Exchange Committee/Library Documentation Committee] prologue: Template and conversion program.** Fritsch, F.N. (Lawrence Livermore National Lab., CA (USA)). Feb 1988. Contract W-7405-ENG-48. 25p.

The SLATEC/LDOC prologue is a standard format for writeups of Fortran subprograms that is acceptable to both the SLATEC Common Mathematical Library Subcommittee and the LLNL Library Documentation Committee. This report presents a subprogram template embodying this standard format and documents the Fortran 77 program SLTOLD that has been written to convert from SLATEC to LDOC form.

32034 **(UCID—21371) Estimation of balloon position from wind data.** Ng, L.C.; Kelly, M.F. (Lawrence Livermore National Lab., CA (USA)). Mar 1988. Contract W-7405-ENG-48. 43p.

The report summarized the mathematical algorithm and the computed results developed for the prediction of a balloon's position uncertainty as a function of time from a given statistical wind velocity profile. The predicted results were used for mission plannings in support of a recent ship launch ballon observation experiment. 30 figs.

32035 **(UCRL—97113) The assessment of human/computer performance using human productivity measures: MIPS and BIPS are MEGAFLOPS.** Banks, W.W.; Schultz, E.B.; Crane, E.; Riley, M. (Lawrence Livermore National Lab., CA (USA); Air Force Logistics Command, Wright-Patterson AFB, OH (USA)). 23 Jul 1987. Contract W-7405-ENG-48. 17p. (CONF-880516—1). NTIS, PC A; 02/MF A01; GPO Dep. Order Number DE87013491/JAW.

From Computer human interaction conference; Washington, DC, USA (15 May 1988).

Multiple logistics processing systems were evaluated using human productivity measures. Comparisons were made to determine which system produced; greater savings in task execution time/errors; minimal task steps; and provided users with the greatest degree of connectivity and error feed back. Multiple assessment methods including interviews, deterministic analysis, and statistical inferential testing were used. Results indicated the superiority of gateway processors and the multiple methods approach. Traditional hardware "bench-marking" assessments topically omit the user, leaving ambiguous results and severe predictive validity limits. Benefits derived from including the human component, include greater levels of predictive validity and causality determinates. 10 refs.

32036 **(UCRL—97342) The relationship between system response time, working memory, and task complexity: An empirical investigation.** Schultz, E.E. Jr.; Uejio, J.Y.; De Alvare, A.M. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1987. Contract W-7405-ENG-48. 12p. (CONF-880516—3).

From Computer human interaction conference; Washington, DC, USA (15 May 1988).

An experiment tested whether: 1) user performance decrements due to system response time (SRT) results from working memory disruption, and 2) SRT effects vary with task complexity. Subjects performed one- and three-step tasks resembling use of a screen editor while attempting to remember zero, three, or six digits. After each task step, SRT's of either zero, two, or six seconds were imposed. SRT increased task completion time, although more for the complex than for the simple task. There was neither a significant interaction between SRT and memory load, nor a main effect of memory load, showing that SRT does not disrupt working memory.

32037 **(UCRL—98211) Effective use of shared memory multiprocessors.** Brooks, E.D. III. (Lawrence Livermore National Lab., CA (USA)). 16 Feb 1988. Contract W-7405-ENG-48. 16p. (CONF-880567—3).

From 3. international conference on supercomputing; Boston, MA, USA (15 May 1988).

We consider two application codes as case studies for the performance of shared memory multiprocessors. The first code is a packet switched network simulator, the second implements a new Monte Carlo algorithm for line transport. The codes are written in a portable parallel extension of the C programming language that can be compiled and executed on several shared memory multiprocessors, and that can be compiled into efficient serial code on any uniprocessor. We find that the latest crop of cost effective shared memory multiprocessors, when effectively used as multiprocessors on a single application, can exceed the performance of a well known supercomputer. 12 refs., 3 figs.

32038 **Sparse Cholesky factorization on a local-memory multiprocessor.** George, A.; Heath, M.T.; Liu, J.; Ng, E. (Dept. of Computer Science, Univ. of Tennessee, Knoxville, TN 37916 (US)). *SIAM Journal on Scientific and Statistical Computing;* 9: No. 2, 327-340(Mar 1988).

This article deals with the problem of factoring a large sparse positive definite matrix on a multiprocessor system. The processors are assumed to have substantial local memory but no globally shared memory. They communicate among themselves and with a host processor through message passing. The authors' primary interest is designing an algorithm which exploits parallelism, rather than in exploiting features of the underlying topology of the hardware. However, part of the study is aimed at determining for certain sparse matrix problems, whether hardware based on the binary hypercube topology adequately supports the communication requirements for such problems. Numerical results from experiments conducted on a hypercube multiprocessor are included.

9903 Information Handling

REFER ALSO TO CITATION(S) 30002, 30056, 30057, 30428, 31130, 31191, 31217, 31219, 31614, 31989, 31997

32039 **(AD-A—189199/3/XAB) IPC for modular software requires a third party connect. Technical report.** Friedberg, S.A. (Rocheste- Univ., NY (USA). Dept. of Computer Science). Jun 1987. 15p. (TR—220). NTIS, PC A03/MF A01.

Reconfiguration, on-line maintenance, load balancing, and similar operations on complex software require (among other things) dynamic binding of communicating peers, so that modules can be installed and removed in a framework of other functional modules. A binding may take the form of TCP/IP protocol connection, remote-procedure call server location, shared memory address resolution, or object-handle resolution, depending on the underlying communication mechanism. However, the need for abstraction and modularity is independent of the particular IPC mechanism(s) being used. A module should not need to know how it is used (specifically, how it is bound together with other modules to implement a more-complex function). Therefore, the bindings between two modules A and B should in general be created and destroyed by a third module C. This facility is called a third-party connect. The module C should not have to have any particular relationship (other than authentication) to modules A and B in order to dynamically connect and disconnect them. In particular, it should not have to be one of A and B, be a common ancestor of them, or have an existing binding to them. Similarly, neither A nor B should have to take an active part in establishing or tearing down bindings.

32040 **(AD-A—189667/9/XAB) Performance of data-compression codes in channels with errors. Final report, October 1986-January 1987.** (Saic Comsystem, San Diego, CA (USA)). Oct 1987. 13p. NTIS, PC A03/MF A01.

Huffman codes, comma-free codes, and block codes with shift indicators are important candidate-message compression codes for improving the efficiency of communications systems. This study was undertaken to determine if these codes could be used to increase the thruput of the fixed very-low-frequency (FVLF) communication system. This applications involves the use of compression codes in a channel with errors.

32041 **(AD-A—189697/6/XAB) Architecture of MRMS simulation: distributing processes.** Sinha, V. (Maryland Univ., College Park (USA). Systems Research Center). 1 Jan 1987. 10p. NTIS, PC A02/MF A01.

The Mobile Remote Manipulator System Simulator is based on an interconnected network of heterogenous computers. The simulation is divided into modules that run concurrently on multiple computers. Modules are designed so that they perform a specific task which can be used in a variety of simulations. As each of these modules is built, it is necessary to provide a method for intermachine/intermodule communication. This paper describes various methods that can be used for this type of communication, and also describes various standard data formats used to get data from module to module in the MRMS Simulator.

32042 **(INIS-mf—11177) Bank of technological experimental data for nuclear power plants with WWER-440 reactors.** Balabanov, E.; Khristova, R.; Ivanov, I.; Dimitrov, B.; Korkinova, M. (Energoproekt, Sofia (Bulgaria)). 1984. 7p. (In Bulgarian). (CONF-8405447—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702357/JAW.

From 6. national conference on thermal and nuclear power problems in Bulgaria; Varna, Bulgaria (17 May 1984).

A computerized system for data acquisition during the start-up and routine operation of WWER-440 reactors is described. The system is implemented on an ISOT-220 microcomputer, and operates interactively with symbolic and numerical Fortran files on magnetic discs. Line printer and xy-plotter can be used, and extesions of the system are possible.

32043 **(LBL—24884) Incremental restructuring of relational schemas.** Markowitz, V.M.; Makowsky, J.A. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 25p. (CONF-880245—1).

From 4. international conference on data engineering; Los Angeles, CA, USA (1 Feb 1988).

Schema restructuring is part of both database design and database reorganization, which are expressions of the specification and evolution of information systems. Entity-Relationship (ER) Consistency expresses the capability of rational databases to model information oriented systems. A relational schema consisting of relation-schemes together with key and inclusion dependencies is said to be ER-consistent if it complies with an entity-relationship structure, meaning that it is representable by an ER-Diagram. Restructuring of ER-consistent schemas consists of the addition and removal of relation-schemes, together with the adjustment of key and inclusion dependencies. Smooth schema modification is characterized by incrementality and reversibility. We propose a complete set of incremental and reversible resetructuring manipulations for ER-consistent relational schemas. We show how the set of schema restructuring manipulations proposed by us back both interactive and view-integration methodologies for schema design. 13 refs., 9 figs.

32044 **(ORNL/DSRD/TM—11) Computer-aided research.** Hartley, D.S. III. (Oak Ridge National Lab., TN (USA)). Mar 1988. Contract AC05-84OR21400. 27p.

A computer system can be an invaluable aid to the author of a professional article by helping him to gather, maintain and use reference notes made during the literature-search phase. The researcher/author can build his own set of cross references "as he goes" and then retrieve those he later determines to be most relevant to his topic. As the data-base continues to grow, the system's usefulness increases.

32045 **(UCRL—97330) Journal de-selection in a biomedical research library: A mediated mathematical approach.** Hunt, R.K. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 9p. (CONF-880542—1). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004001/JAW.

From 88. annual meeting of the Medical Library Association; New Orleans, LA, USA (20 May 1988).

This paper presents the mathematical formula developed for journal de-selection decisions. The formula factors in subscription cost, shelving and storage cost, interlibrary loan cost, staffing cost,

and usage level to determine the {open quotes}institutional cost ratio{close quotes} which serves as an indicator of the cost-effectiveness of subscribing to each title. Once the institutional cost ratio was calculated for each of the 537 titles, a committee of library staff and senior library customers reviewed the ranked list to decide which subscriptions should be canceled based on the rankings. The committee also considered possible exceptions based on subjective criteria such as availability at local libraries, unrecorded usage, and relative importance of the journal. The preliminary cancellation list was then reviewed by the researchers who use the Library. The researchers were able to justify Library subscriptions to a few additional titles. By using this method, we were able to cut our subscription costs by 46{percent}, while cutting only 8{percent} of the total usage. In addition, by mediating the mathematical approach with human intervention, we were able to make these severe cuts without unduly distressing our patrons.

9904 Law

REFER ALSO TO CITATION(S) 29999

32046 **(INIS-BR—1050) Consequences of bilateral and multilateral restrictions in the Brazilian Nuclear Program.** Alves, R.N. (Comissao Nacional de Energia Nuclear de Brasil, Rio de Janeiro). 1987. 11p. (In Portuguese). (CONF-8709269—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88702314/JAW.

From Seminar Brazil and the international nuclear policy; Vienna, Austria (16 Sep 1987).

A brief historical aspects on research activities for the nuclear energy development, the historical antecedents related to restrictions in the international cooperation agreements and, the Brazilian relationship with the international nuclear policy, are presented. (M.C.K.).